

CONFIGURING A NETWORK OPERATING SYSTEM

After reading this chapter and completing the exercises, you will be able to:

- ◆ Identify network operating system (NOS) characteristics and versions
- ◆ List NOS hardware requirements
- ◆ Perform NOS installations and upgrades
- ◆ Properly shut down the NetWare, Linux, OS/2, Windows NT, and Windows 2000 network operating systems

Most enterprises do not run a single network operating system (NOS). Instead, there is often a mix of NOSs that you must be prepared to administer. Although it is beyond the scope of this chapter (and book) to detail each operating system's features and functions, it will be important for you to know the general capabilities and minimum hardware requirements of the major NOSs, and how to ensure compatibility with installed devices. This chapter covers general installation procedures, how to configure virtual memory swap files, how to perform upgrades, and how to properly shut down the Novell NetWare, Linux, OS/2, Windows NT 4.0 Server, and Windows 2000 Server NOSs.



Several operating systems include automated setup installations that require little or no interaction. This book addresses only the interactive installation you would normally see in a manual, step-by-step installation.

GENERAL NOS CONFIGURATION CONCEPTS

Although each network operating system covered in this chapter has its own configuration process, all NOS configurations involve some general elements and concepts that I briefly describe before detailing how those elements are implemented in individual NOSs.

Hardware Requirements

This chapter is organized by network operating system, and each respective section will list the minimum system hardware requirements for that NOS, including requirements for processor, RAM, and hard disk space. Each NOS also requires a keyboard, mouse, CD-ROM, network card, and VGA or better video display, but for this chapter I assume that these items are always present.

Vendors list the minimum requirements as a standard practice and also to qualify for various types of contracts for which a bid is required (government contracts, for example). However, these requirements are usually only sufficient to install the operating system — how well it runs is another matter. A production server will languish in attempting to provide service to the network with only the vendor's recommended minimum requirements.

Preparing server hardware for NOS installation involves the right perspective. Instead of trying to get away with as little as possible, the administrator's perspective should be nearly the opposite: obtain hardware that is powerful enough for current and future requirements. Administrators must remember to anticipate what kinds of demands will be placed on the server. Is it a file server? Better have a lot more hard disk space than the manufacturer recommends. Is it going to run applications such as a database? Better also add a lot of memory and much more processing power. Will the server provide intranet or Internet web content? Add another network card or two for load balancing or adaptive fault tolerance.

NOS Installation

A common task in server administration is installation of the NOS. Before you start the installation, be certain that the installed hardware meets at least the minimum system requirements as recommended by the vendor, and also be certain that installed devices are compatible.



Before you begin any NOS installation, write down the following information for which the installation may prompt you: an IP address for the server, an IP address of a DNS server, the name of your domain, the name of your computer, and so forth.

Virtual Memory/Swap Files

In addition to giving hardware requirements for various NOSs, this chapter also explains how each NOS deals with virtual memory, an important area of configuration for a network operating system. **Virtual memory** uses a portion of hard disk space to extend RAM. It is a logical (as opposed to physical) memory area that is supported in conjunction with physical RAM. Think of virtual memory as an alternate set of memory addresses. Programs use these virtual addresses rather than real addresses to store instructions and data. These virtual addresses are then converted into real memory addresses when the program or data is actually required. The main goal of virtual memory is to enlarge the address space that a program can use. To facilitate the copying of virtual memory into real memory, the operating system divides virtual memory into pages, each of which contains a fixed number of addresses. Each page is stored on a disk until it is needed. When the page is needed, the operating system copies it from disk to main memory, and translates the virtual addresses into real addresses.

The process of translating virtual addresses into real addresses is called **mapping**. Copying virtual pages from disk to main memory is known as **paging** or **swapping**. Swapping is a useful technique that enables a computer to execute programs and manipulate data files larger than main memory. The operating system copies as much data as possible into main memory, and leaves the rest on the disk. When the operating system needs data from the disk, it exchanges a portion of data in main memory with a portion of data on the disk. Each time a page is needed that is not currently in memory, a **page fault** occurs. An invalid page fault occurs when the address of the page being requested is invalid. In this case, the application is usually aborted. All major NOSs require virtual memory. This chapter explains how to create swap-file space for each respective NOS. (Chapter 11 addresses how to optimize and size the swap file.)

Performing Upgrades

Sometimes it is not necessary to “flatten” the system (use FDISK to repartition and format the disk). Although a clean install has advantages, sometimes it can be disruptive, time-consuming, and unnecessary. When upgrading a system from one released version to the next (Windows NT 4.0 to Windows 2000, for example), it might be best to take 15 minutes or half an hour to perform an upgrade, which will retain all the existing applications and many configuration settings. Compare this to perhaps a day for a clean install depending on the number of applications and configurations that you need to make. When Microsoft initially began the daunting task of upgrading its data center of more than 350 servers, administrators flattened NT 4.0 systems and performed clean installs of Windows 2000. Microsoft decided to perform upgrades instead on some servers, and noticed that there was no appreciable difference in stability or function. Thereafter, Microsoft upgraded the rest of its systems.

While upgrades don't work smoothly for everyone under all circumstances, you should consider the time savings involved. Although NOS upgrades are not specifically a CompTIA Server+ exam item, they are an important part of administration. Administrators considering a mass upgrade will want to test and pilot first (see Chapter 6), and if successful, perform the remaining upgrades.

Proper Shutdown

Although servers will ideally run indefinitely without a need for maintenance, whether planned or unplanned, you will eventually have to shut down or reboot a server. Often, this is necessary to return a server to healthy status when its performance is poor or it seems unstable. Most network operating systems also require a reboot any time you make a significant change such as adding hardware, a service, or an application. A shutdown might also be required for the mundane but regular task of blowing dust out of the case. For whatever reason, you should know how to properly shut down various operating systems, because an improper shutdown can corrupt data files, applications, and the operating system itself.

When performing a planned server shutdown, it is critical for system administrators to have a good grasp of how the servers and clients are being used and actively involve users in scheduling downtime. The concepts behind performing a proper shutdown are fundamental to all network operating systems. For example, on most systems, a server shutdown will cause all user processes to be killed. If users on a system are running tasks that take a long time to complete, then shutting the system down and killing all of the processes will severely impact the productivity of users—possibly resulting in data loss. Also, user workstations might lock up or hang while waiting for some kind of response from the server. Therefore, whenever possible, administrators should give users as much lead time as possible when scheduling a shutdown. Server operating systems discussed in this book are generally stable enough to seldom, if ever, need a shutdown (except for regular maintenance).

NOVELL NETWARE

Novell NetWare is a widely accepted local area network (LAN) operating system that was developed by Novell Corporation. NetWare runs on a variety of different LANs, including Ethernet and IBM Token Ring networks, and was arguably the NOS market leader until the mid '90s when Windows NT 4.0 came on the scene. NetWare offers users and programmers a reliable interface that is independent of the underlying hardware that transmits data. Depending on the version, NetWare uses either a bindery or directory service design to manage the majority of the resources.

A **directory service** is a network service that identifies all of the resources on a network and makes them available to applications and users. These resources can include email addresses; user, group, and computer accounts; and devices such as printers. A main

goal of a directory service is to make the physical network topology and protocols invisible so that a network user can access any resource without knowing where it is or how it is physically linked. Three of the most important directory services are **Lightweight Directory Access Protocol (LDAP)**, a standard that defines a method of creating searchable network resources and is used primarily for accessing information directories such as Windows 2000 Active Directory and NetWare Directory Service (NDS), which is used on Novell NetWare networks. Virtually all directory services are based on the **X.500 ITU** standard, originally a standard for searching email directories. However, the standard is so large and complex that no vendor complies with it completely.

The NetWare operating system has the following characteristics:

- NetWare 3.x uses a bindery to provide network clients with the information that is stored on the NetWare server's local directory partitions. A **bindery** is restricted to the server on which it resides, and users can only use resources managed in the same bindery to which they log on. If users want to access resources located in another part of the network, they must log on to another server's bindery.
- NetWare 4.x and 5.x use the more advanced **Novell Directory Services (NDS)**. NDS uses a scalable tree structure that extends throughout the enterprise. The administrator can plan and configure the NDS tree so that users from anywhere in the organization can access resources throughout the organization with a single logon.
- NetWare 5.1 incorporates new web and application server technologies that extend an organization's contact to the realm of e-business and web-based network management. NetWare 5.1 includes tools to make the once-complicated process of web application development, deployment, and management much simpler. Novell NetWare works well with most client operating systems, ranging from MS-DOS to OS/2 and any version of Microsoft Windows.
- NetWare 5.1 offers a GUI interface known as **ConsoleOne**, which is a central management point for performing NetWare administration. This console remedied complaints about the text-only administration of previous versions of NetWare (see Figure 8-1).
- **Zero Effort Networks (Z.E.N. or ZENworks)** is a NetWare suite of software management tools that administrators use to manage the user or server operating system environment by automatically distributing applications and controlling the user desktop using ZENworks for Servers and ZENworks for Desktops.
- Using NetWare 5.1, your network can run in a pure IP environment without retaining older IPX-based functionality. (Older versions of NetWare used IPX/SPX as the default network protocol.)

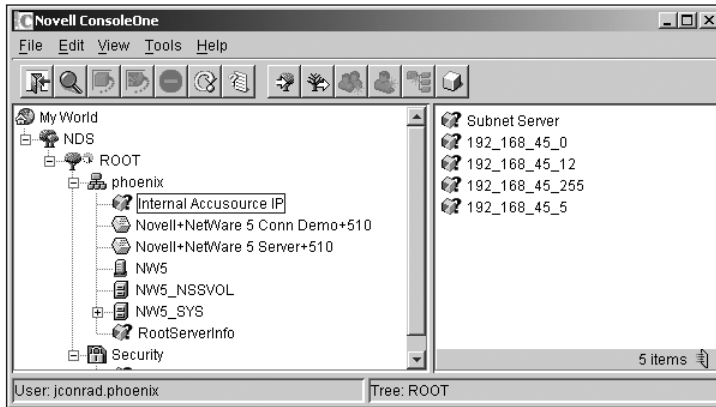


Figure 8-1 The NetWare 5.1 GUI interface, ConsoleOne

Prior to the Internet's rapid growth, using IPX/SPX was not a significant administrative concern. However, administrators trying to merge existing IPX/SPX networks with other IP-based servers and the Internet will appreciate the simplification of using a single protocol. By using only IP traffic, your organization can:

- *Reduce the routing burdens associated with forwarding multiple protocols.* This benefit is twofold: First, the administrator does not have to program and maintain routers with both IPX and IP forwarding information; second, reducing the routing load to a single protocol extends the effectiveness of the router. For example, you might have to replace a saturated router in the IPX/SPX and TCP/IP environment. However, scaling down to only TCP/IP might reduce router traffic to the point that you can save a great deal of money by keeping the existing router.
- *Conserve valuable network bandwidth.* Instead of transmitting two protocols over the wire, each host transmits only one.
- *Eliminate the need to support other client protocols* on desktop computers.
- *Optimize remote connectivity.* Transmitting multiple protocols makes an already slow dial-up modem connection even slower.

Versions

There are several versions of NetWare in use today. The most recent version, and the subject of the rest of this section, is NetWare 5.1. Here are the different versions of NetWare:

- NetWare 2.12
- NetWare 386 (became NetWare 3.11)
- NetWare 3.12
- NetWare 4.0 – 4.1
- IntraNetwork 4.11

- NetWare 5.0
- NetWare 5.1

You are most likely to find NetWare 3.12 or later in production environments.

NetWare 5.1 Minimum Requirements

The minimum hardware requirements for a NetWare 5.1 server are as follows:

- A server-class PC with any Pentium II or higher processor.
- A DOS partition that will start the server and load the NetWare operating system. While the partition can be as small as 30–35 MB, Novell recommends 100 MB, which is very little considering the size of modern hard disks.
- At least 1.3 GB of disk space on the SYS volume beyond the DOS partition is needed for the standard NetWare components and WebSphere Application Server for NetWare. (**WebSphere** is an IBM application for building and managing web-based applications.)
- 128 MB of RAM is required for the standard NetWare components. Installing the WebSphere Application Server for NetWare requires 256 MB. Novell recommends 512 MB for higher-end servers.

The base software requirement to start the installation is DOS 3.3 or later. You can use a non-Microsoft version of DOS; Caldera DR-DOS 7 is included on the NetWare 5.1 License/Cryptography disk. The other software components that you will need are the NetWare 5.1 Operating System CD, the NetWare 5.1 License disk, and the Novell Client for DOS and Windows 3.1x. This client is useful for installing NetWare from an IPX NetWare server over the network. You will need the proper DOS CD-ROM drivers for your CD-ROM as well, unless the CD-ROM is bootable.



If this is the first NetWare 5.1 server on your network, you must make sure that this server will be a reliable, accessible, and continuous part of the network, because it lays groundwork for the remainder of the enterprise installation and must be available.

You must have Supervisor rights (which allow you to perform administrative tasks) at the root of the NDS tree. If this is not the first NetWare 5.1 server on the network, you must have Supervisor rights to the container where the server will be installed. (A **container** is a general term for an Organization or Organizational Unit, which are hierarchical components of the NDS tree. All network objects must reside in a container in the tree.) You will need to have read rights to the Security container object for the NDS tree as well.

You may also need some optional client connection utilities for installing from a network such as the Novell Client for DOS and Windows 3.1x. This allows you to boot a computer from DOS or Windows 3.x, connect to an IPX network share on a NetWare server running IPX, and install NetWare. If connecting to an IP server, use the IP Server Connection Utility instead.



Creating a floppy that both loads the appropriate network card drivers and connects to an IP host over the network can be quite time-consuming, frustrating, and filled with trial and error. Fortunately, Novell includes specific instructions for creating such a floppy in the file named `Products\serverinst\ipconn.txt` on the Novell client CD. Although these instructions don't work for every network card and every IP network connection, at least they provide a good groundwork for creating your own IP network boot floppy.

This book makes no attempt to detail each individual step in performing an operating system installation. Instead, the purpose of each respective operating system's installation section is to provide an overview of the installation process.

Installing NetWare 5.1

To install NetWare 5.1 on a server:

1. Create an MS-DOS primary partition and set it to active using FDISK. This will be your boot partition that boots to DOS and loads NetWare as well as any drivers for your CD-ROM, SCSI drives, and so forth. The installation will suggest a partition size for you. If you want to record **memory core dump** data (a representation of the contents of memory in the event of a problem, also known as simply a “memory dump”), size the partition to the recommended size plus the amount of RAM in your system. For example, if the installation recommends 100 MB and you have 512 MB of RAM, the optimum partition size would be 612 MB. Most server operating systems offer some facility to store memory dump data, but it is extremely complex and is usually meaningful only to programmers adept at its interpretation.
2. If you boot from the CD-ROM, the installation automatically seeks a suitable boot partition and, if none is found, offers to create one for you. This partition will contain the necessary files to start NetWare.



Creating a bootable partition during installation will delete all data on the hard disk, even data on other partitions.

3. Booting from the NetWare 5.1 installation CD starts the installation for you. If using a boot floppy to access the CD-ROM, insert the NetWare 5.1 CD. At the CD drive or network drive prompt, enter `Install`. The initial screens of the installation program will display in text-based mode. You can accept the detected and default settings, or you can modify the settings to meet the needs of your networking environment. You can also start the installation by booting with the network floppy mentioned earlier to access the installation files from a server.



Booting from a floppy requires you to create a bootable MS-DOS system disk with drivers for your CD-ROM drive. Also, you must create an Autoexec.bat and Config.sys file and make sure that the logical filename of your CD drive (specified in the Config.sys and Autoexec.bat files) is not CDROM or CDINST. The Config.sys file must contain a FILES=40 and BUFFERS=30 statement.

4. As you go through the installation, you will see prompts to confirm or select various hardware in the system. For example, Figure 8-2 shows that NetWare detected several drivers that would work for the installed NIC, so I had to choose the correct one.

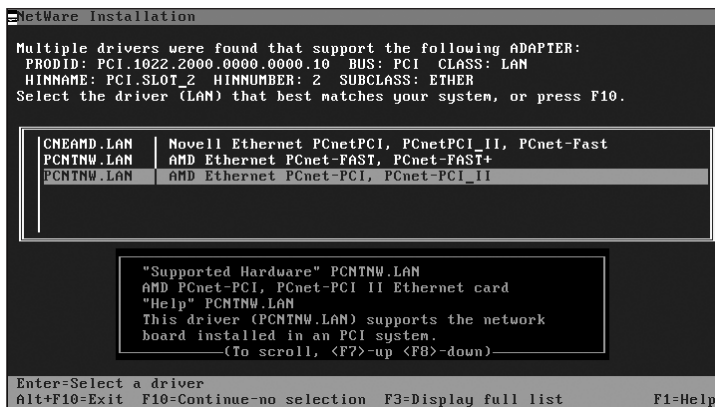


Figure 8-2 Verify or select the correct hardware during NetWare installation



I recommend using a NIC that is known to be automatically detected by the installation. Otherwise, you must specify the make and model of the network card from a list or provide the drivers from a floppy. Unfortunately, some NIC manufacturers no longer make a NetWare driver, so this might be limiting. After specifying the NIC, specify its resources such as IRQ, I/O port, and so forth. This can involve a great deal of trial and error as you determine which resources are available and which resources work with that particular network card. Automatically detected cards usually do not require you to manually specify resources.

5. Choose how you want to partition the hard disk space (see Figure 8-3).



The first volume NetWare creates is called the SYS volume, and Novell recommends you make it at least 200 MB (a complete install with all documentation requires about 600 MB). This volume should be used for only NetWare system files and **NetWare Loadable Modules (NLMs)** (NetWare programs and applications)—not user data. This makes recovering a problematic system easier and faster, especially for backup and restore, and if you need to reinstall the SYS volume, doing so does not destroy user data.

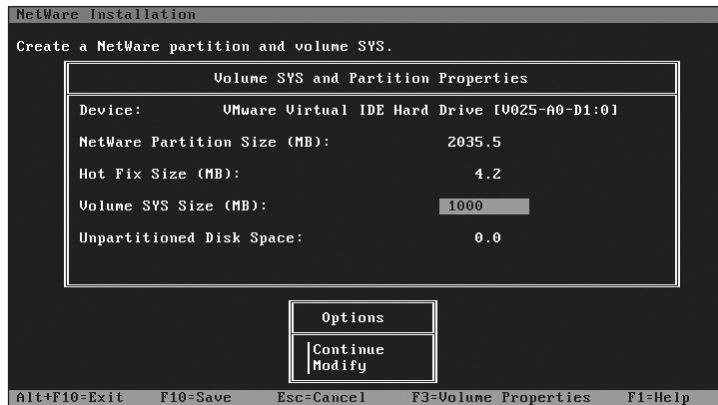


Figure 8-3 Choose how you want to partition the hard disk space

6. Continue with the installation and into the GUI mode, answering the questions based on your organizational requirements.



During the text-based installation, much of your hardware is automatically detected, but do not expect this detection to be as thorough as Windows Plug and Play. Be familiar with the exact hardware in the server, because you might have to inform the installation of several items such as storage adapters (IDE or SCSI), PCI hot plug capability, or network boards. For example, if installation does not properly detect your network card, you will have to manually select it from a list of network boards or have the NetWare drivers for the card available on disk, and you might also have to enter the hardware resources that the board requires (IRQ, I/O address, and so forth).

Most of the NetWare 5.1 installation steps are self-explanatory; however, there are some key issues that you will need to address during the installation process, as follows:

- Decide which version of NDS you will use. NetWare 5.1 allows you to use either NDS 8 (default) or NDS 7. NDS 8 provides the enhanced NDS functionality needed by many new web networking products, such as WebSphere. If your NDS tree has not already been updated for NDS 8, you must have Supervisor rights at the root of the NDS tree to install NDS.
- You can create two types of volumes during the installation process: traditional NetWare volumes or Novell Storage Services (NSS) volumes, as discussed in Chapter 5. If you want an NSS volume, you must leave unallocated space on the hard disk and create the NSS volume after you have installed NetWare and booted the server.

- Specify the amount of space for a **hot fix** redirection area on the hard disk. NetWare verifies the integrity of all disk writes, and if a write fails this verification, the data is redirected to the hot fix area and the original destination is marked as unusable. The default size of the hot fix area is a small percentage of a partition's total size.
- As mentioned earlier, NetWare 5.1 can process IP network packets and traditional IPX packets. You can install networking protocols to support IP, IPX, or both. In the GUI installation stages, you can specify protocols. Novell's IPX allows you to continue using IPX-based applications. If IPX is the only protocol installed on your server, it will actively process IPX packets and ignore packets using other protocols, such as IP. If you have network clients or applications that require IPX and IP, you can install both protocols at the expense of more network traffic from clients as both protocols broadcast and communicate.



You can also install IP with IPX Compatibility. This binds both protocols to a network card, with preference for communicating over IP. IPX is in passive mode, dormant until an IPX request arrives. Then, NetWare communicates using IPX. This is a graceful way to transfer to IP and support both protocols at a low cost to network bandwidth.

- Don't forget to enter a **host name record** (otherwise known as an "**A**" **record**) for the server prior to installation on your DNS server. During installation, you will enter one or more DNS name servers, and the NetWare server must be able to locate the name server and verify the host record. This is required in order to allow clients to find the server using its host name. (Chapter 9 further explains DNS.)
- You will either join the server to an existing tree or create a new one. A NetWare tree defines the structure of the organization, its subdivisions, and the objects contained therein. Objects (a resource such as servers, printers, users, and groups) reside in a context within the tree. Think of a context as a subdivided portion of the tree. For example, you install a file server for the graphics department of a company named KidHelp in Phoenix. The tree might be named KidHelp, and within that tree is the context. The context of the file server might appear something like O=Phoenix,OU=Graphics. (The root name is implied; you don't need to specify it when naming objects.)
- Finally, NetWare 5.1 must have a valid license in order to function as a server. You can install the license from the NetWare 5.1 License/Cryptography disk or browse to a directory that contains NetWare 5.1 licenses. Although the server can be installed without a license, the unlicensed server will allow only two user connections. After installation, you can use the NetWare Administrator utility to install additional licenses.

NetWare servers by default start from the MS-DOS partition when you turn on the server. If you like, you can start the server manually as follows:

1. Turn on the power, and the system will boot to an MS-DOS prompt on the boot partition (usually C:\).
2. Start the server by accessing the `nwserver` directory—type `CD \nwserver` and press Enter.
3. Type `server` and press Enter. The server starts and launches into the GUI. Many experienced NetWare administrators prefer to do a lot of the administration at the command line. You can close the GUI if you like and perform administration from the command console.



You can also place these actions in `Autoexec.bat` to automatically start the server.

Creating NetWare Swap-File Space

Except for the SYS volume, NetWare volumes do not have default swap-file space. It is not advisable to use only the SYS volume for swap files, because this volume is typically already very busy. Instead, you should place one or more swap files on other high-performance volumes with plenty of free space. To add a swap file to a volume, execute the `SWAP ADD` command from a server console prompt. It does not matter if the volume is **mounted** (that is, ready for use). If not mounted, the swap file is created once you mount the volume. Swap files are deleted when the volume is dismounted, requiring you to re-create the swap file when it is mounted again. To avoid this inconvenience, you can add the `SWAP ADD` command to the startup file, `Autoexec.ncf`. NetWare swap files are dynamic, becoming larger or smaller as necessary. You can learn more about the `SWAP` command by typing `swap add` at a server console prompt.

Performing an Upgrade to NetWare 5.1

If you are upgrading an existing server from a previous version of NetWare, the installation will detect the previous version and prompt you to either upgrade or start a new installation. Upgrading will retain all your server data such as files, directory structures, partitions, and volumes. During an upgrade, the upgrade program may skip entire sections otherwise seen in a new installation, as the upgrade program automatically detects and configures several of the setup tasks. You can upgrade an existing server running NetWare 3.x, NetWare 4.x, or NetWare 5 to NetWare 5.1.

Before introducing a NetWare 5.1 server into an existing network that contains NetWare 4.x servers, run the NetWare Deployment Manager to prepare the NetWare 4.x version of NDS for an upgrade to NetWare 5.1 NDS.



To update an existing NetWare 4.x network to NetWare 5.1, you must log on from a Windows 95/98 or NT workstation as a Supervisor. Next, run NetWare Deployment Manager (Nwdeploy.exe) from the NetWare 5.1 Operating System CD and complete the network preparation tasks.

After you have completed the Network Preparation section of NetWare Deployment Manager, you should prepare the computer to be a NetWare server. NetWare 5.1 simplifies the NDS upgrade process by verifying that your NDS tree is ready for the version that you choose to implement.



Access more in-depth information on installation and upgrading to Novell NetWare 5.1 at www.novell.com/documentation/.

Performing a Proper NetWare Shutdown

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To properly shut down a NetWare server:

1. Close the GUI by clicking the red Novell item in the lower left corner of the screen.
2. Select the Close GUI item, and answer “Yes” to the confirmation prompt. When the GUI closes, you are left at the “Servername:” prompt, where servername is the name of the NetWare server.
3. Type *down* and press Enter to close all services and files. A handy feature of NetWare is that in this process, a notification of the downed server is delivered to all attached workstations. If you would rather just reboot the server, type *restart server* and press Enter.



For NetWare 4.11, you must also type *exit* and press Enter.

4. At the C:\NWSERVER prompt, turn off the power.

UNIX/LINUX

I don't typically like to give history lessons on computing, but for UNIX, it is relevant and explains why there are dozens of different versions. UNIX is an interactive time-sharing operating system invented in 1969 by Ken Thompson. Brian Kernighan and Dennis Ritchie, the inventors of C, are also considered coauthors of the operating system. UNIX is a popular multiuser, multitasking operating system designed to be small and flexible and used mostly by programmers. Although it has developed significantly over the years, UNIX still uses its original cryptic command names along with its general lack of user friendliness. This is changing, however, with graphical user interfaces such as **X Windows** and **GNOME**.

UNIX has been a popular choice among universities and corporations because of its low cost and the fact that programmers familiar with the C high-level programming language can modify the code to specific requirements. UNIX has split into two main dialects: AT&T's System V and the University of California, Berkeley version known as BSD 4.1, 4.2, or 4.3. Within the two main versions, there are dozens of other modified versions ("flavors").

Most UNIX flavors are designed for CISC-based computing. For our purposes, we will focus on Linux, because it is a PC-compatible flavor of UNIX, the Server+ exam is PC-centric, and most anything that would be true of Linux for our purposes also applies sufficiently to UNIX.

Linux is a version of UNIX that, like other flavors, is open source code. Linus Torvalds authored early versions of Linux with the objective of creating a relatively small UNIX source code that would run on Intel-compatible computers (as opposed to the CISC-based processors of other UNIX versions). Boxed versions of Linux available from the vendors listed in the next section of this chapter are preferable in many cases, because although you have to pay for the boxed version, the coding has already been tested, associated tools are included, and technical support is available. Linux has become one of the hottest operating systems in the past few years, and has unexpectedly begun to compete strongly against Microsoft Windows NT/2000.

One potential challenge to the new Linux user is the plethora of new commands, features, applications, and other components. As you familiarize yourself with Linux, realize that much of its administration, especially with early versions of Linux, involves the command line. If you are accustomed to MS-DOS commands, you will have to make a point of *not* using MS-DOS commands in Linux: They don't work. You can tap into more about Linux commands by looking on the hard disk at the `/usr/doc` files after installation is complete. On all Linux distributions, there is a huge amount of miscellaneous documentation stored in this `/usr/doc/` directory. Each version of Linux makes its own directories under `/usr/doc` where it places files like FAQs and installation guides. There are many sources of information on Linux on the Internet as well. One central clearinghouse is the Linux documentation project located at www.linuxdoc.org.

Linux offers all the services and features you would expect to see on a server, including:

- IP services like DHCP, DNS, web hosting, and firewall support
- Application support for a wide range of applications such as IBM's main-stream database product, DB2, Sun Microsystems's office suite, StarOffice 5.2, and Computer Associates' ArcServIT backup software
- Mail server services
- File and printer services
- SMP support
- E-commerce support
- Clustering and load balancing

Versions

There are several versions of Linux because of its open source code, and there are many vendors from whom you can obtain boxed sets of Linux. The major Linux vendors are listed here:

- *SuSE Linux*. You can find an installation guide in several different formats for SuSE on an FTP server at <ftp://ftp.suse.com/pub/suse/i386/current/docu/>.
- *Caldera Linux*. This company also offers Caldera Volution, which is a Linux management solution designed for network management. You can get more information on this flavor at www.caldera.com.
- *Mandrake Linux*. The install guide for this Pentium-optimized Linux version can be found at www.linux-mandrake.com.
- *Debian Linux*. You will find the “Guide to Installing the Free Software Foundations Debian Linux on Intel-Based Machines” at www.debian.org.
- *Red Hat Linux 7.x*. This is probably the most popular build of Linux. The Red Hat “Getting Started Guide,” installation FAQs, and other important documentation can be downloaded from www.redhat.com/support/. The FAQs list minimum system requirements in addition to more technical issues. Unless stated otherwise, Linux references in this book are to Red Hat.

Linux Minimum Hardware Requirements

Unlike some other versions of UNIX for the PC, Linux is very small. You could actually download one of the smaller, free releases and run an entire system from a single high-density 5.25-inch floppy! To run a complete Linux system on today’s computers, there are obviously other hardware requirements. Linux, because of its open source nature, is continuously expanding, with more features being added every day. Hardware compatibility is very broad, especially compared to the earliest releases of Linux. Check with the Linux vendor, but most commonly available video cards, SCSI drivers, NICs, and so forth should be supported.

Linux hardware requirements are humble, but particular. You do not need to have the most advanced or most recent server to run Linux. As with all operating systems discussed in this chapter, there are two primary options for obtaining a computer to run Linux. The first option is to buy a computer with Linux preinstalled. In my view, this is the best alternative if you need a business server or high-performance workstation, and it applies to all NOSs. You can choose from brand-name machines like Dell, VA Research, Compaq, HP, and many other top PC manufacturers. Red Hat posts a list of certified systems by manufacturer on its web site (www.redhat.com). Also look for upcoming systems that will use the 64-bit processing power of the AMD Sledgehammer.

A second viable option is to use an existing PC or assemble one and then perform a custom Linux installation. This is somewhat more common in the Linux community because of a “do-it-yourself” attitude prevalent among Linux fans. A disadvantage to rolling out your own Linux implementation is that there is no support except for what is freely available through newsgroups and web sites. If a critical Linux server experiences a failure, you are unlikely to have the patience required to post a newsgroup message and then wait a couple of days for an answer (if any). With major server vendors, you usually have 24/7 emergency software and operating system support as well as overnight delivery for failed hardware.

Hardware compatibility is most important if you are installing on an older system or building a new system from scratch. Red Hat Linux 7.x should be compatible with most hardware in systems that were factory built within the last couple of years. With hardware specifications changing almost daily, however, there is never any guarantee that your hardware will be 100% compatible. Therefore, you should collect all of the system hardware information that you can. *The Official Red Hat Linux Reference Guide* on the Documentation CD has instructions in the Installation-Related Reference area (including instructions for Windows users) that will assist you. You can also use Red Hat’s online resources to make sure that your hardware is compatible. The easily navigable hardware compatibility list is located at: hardware.redhat.com.

Linux hardware requirements are somewhat inexact since multiple vendors have different requirements. However, for a basic installation, most any server should suffice. This is because Linux code is exceptionally trim compared to larger operating systems such as Windows 2000 Server with its 40 million lines of code. However, as with other NOSs, remember that more is better when it comes to running a production server. General minimum hardware requirements for Linux are as follows:

- *Intel 80386 processor or higher.* Intel-compatible processors such as AMD and Cyrix also work with Linux.
- *32 MB of RAM.* Although you can locate and download very thin Linux versions requiring as little as 2 MB, feature-complete Linux versions such as Red Hat Linux usually recommend 64 MB.
- *500 MB of hard disk space.* Although if you install absolutely all features in a Red Hat installation, you’ll need nearly 2 GB. (So much for the trim Linux OS.)

Installing Linux

Linux is very flexible about coexisting with other operating systems, and the **Linux Loader (LILO)** allows you to select which operating system you want to boot when you start the server. As a general rule, configuring the system to boot to more than one operating system is usually a smoother process if you install the other operating system(s) first, and Linux last.



When you read Red Hat Linux documentation, you might see mention of a partitionless installation. Do not mistake this to mean that the installation does not use a partition at all. A **partitionless** installation is a reference to using an existing DOS or Windows partition instead of creating a partition manually during installation using FDISK or Red Hat's **Disk Druid** partitioning tool.

Although you can choose from several methods to install Red Hat Linux, this chapter assumes installation from the CD-ROM. Absent the CD-ROM, you can make an installation floppy disk to initiate an installation, for example, because you downloaded Red Hat Linux rather than purchasing an official boxed set. You need to use the Linux boot floppy to launch the installation as opposed to booting an MS-DOS floppy and running Setup.exe. To begin the process, you will need a blank, formatted, high-density (1.44 MB) 3.5-inch floppy disk. The images directory in the Red Hat Linux source files contains the boot images for various contexts such as a standard boot to the Linux installation program, activating a PCMCIA socket, or booting to a Linux network share location. Extract the image file to a floppy using the *rawrite* utility found in the dosutils directory.



If your system doesn't support a CD-ROM (**El Torito**) boot, Red Hat Linux offers another choice that still allows you to start the installation directly from a CD-ROM. Use a boot floppy that loads your CD-ROM drivers (such as the Windows 98 boot floppy) and run the Autoboot.bat file from the \dosutils directory on the Linux CD-ROM to start the installation. (You cannot just boot to the floppy and then run a Setup.exe or Install.exe file from the CD-ROM.)

Although you can use a text-based Linux installation, we will assume use of a GUI installation. You can select the same options during both installations, except that the GUI version also offers explanations of your options to the left of the screen and is more intuitive. At the opening installation screen, press Enter or wait 60 seconds for the GUI installation to automatically begin. (If you insist, you can type *text* and press Enter at the Welcome screen to enter text-based setup.) As with the other NOS installations addressed in this chapter, not every installation step and option is listed. However, the basic Red Hat Linux 7.0 steps are as follows:

1. Select the installation type: Workstation, Server System, or Custom System. One of the primary differences in these installations is how the partitions are handled (see Figure 8-4).

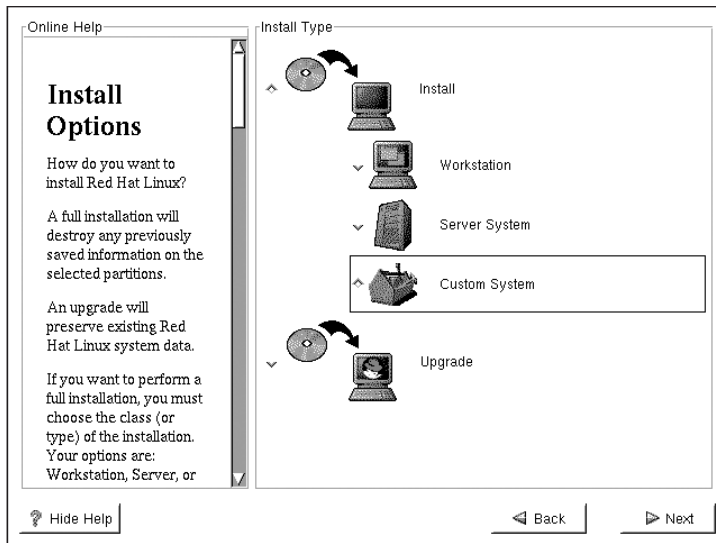


Figure 8-4 Select a Linux installation type

- *Workstation*: Removes all existing Linux partitions on all disks, and then uses all available unpartitioned space for the installation. Non-Linux partitions are left alone, and you can still boot to them after the Linux installation.
- *Server System*: Removes all partitions on all drives!
- *Custom System*: Provides an opportunity for you to manipulate free space and existing partitions to your liking.

We will proceed under the assumption of installing a Custom System.

2. Configure partitions using either the Red Hat Linux Disk Druid utility or FDISK. As a minimum, you will need:
 - Root partition (“/”), which is the main repository for files (except boot files).
 - Swap partition equal to the amount of RAM in the system or 16 MB, whichever is larger.
 - Boot partition (“/boot”), which contains the OS kernel, and as the name implies, boots to Linux. This partition does not need to be large and is usually no larger than 16 MB.
 - Using the Disk Druid utility, you can also create a RAID 0, 1, or 5 array, and other partitions as it suits your needs. Figure 8-5 shows the Disk Druid utility being used to create partitions.

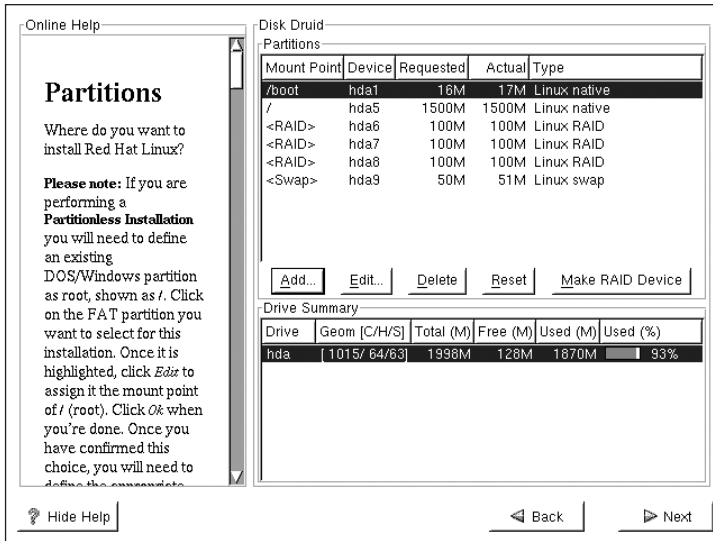


Figure 8-5 Creating partitions with Disk Druid

3. Enter the server's network configuration, including IP configuration, host name, gateway, and DNS server(s) (see Figure 8-6).

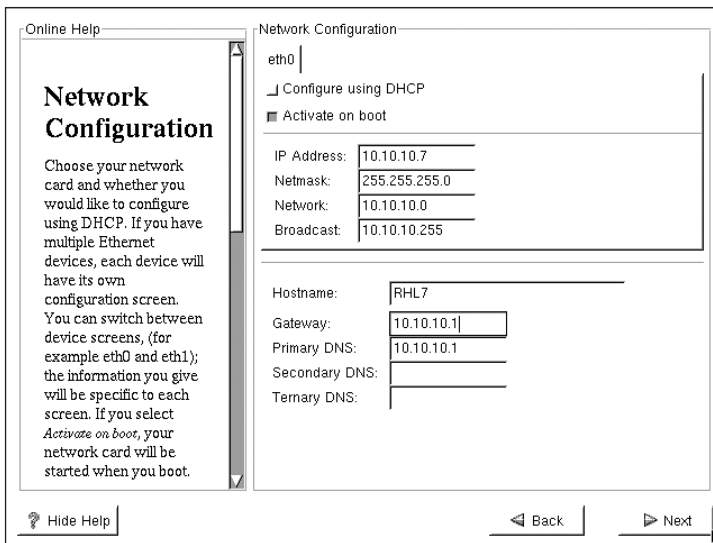


Figure 8-6 Configuring Linux IP settings

4. Select a root password, which allows you to completely administer the server. Also add one or more user accounts.

5. If you want to use security mechanisms such as MD5 passwords or Kerberos, configure the appropriate information.
6. Select the various features you want to install and proceed through the installation. Setup creates partitions as specified and copies installation files to the hard drive.



As addressed in Step 2 in the Installing Linux section, you create Linux swap-file space during installation using the Disk Druid utility.

Performing a Proper Linux Shutdown

There are three possible states you can end up in when you shut down a Linux server. You can place the server in one of these states either from a GUI interface or an **X Term** session, which is a text-based terminal interface within your GUI. The first state, while not technically a shutdown, is single-user mode. System administrators will often bring a UNIX system down to **single-user mode**, which closes user connections, to perform full backups of the file system, ensuring that there are no locks on open files. This is not a complete shutdown because the operating system is still running and the processor is still active, but from a network user perspective it is. To enter single-user mode, access a boot prompt and enter *Linux single*. When finished, you can restart the computer by pressing Ctrl+Alt+Del or entering the shutdown `-r` command (see below).

A second state is to completely shut down the system so that it is ready to be powered off. A complete shutdown is often done when hardware maintenance is planned for the machine or any other time the machine is to be powered off. A shutdown of this type uses the shutdown `-h` command (`-h` meaning “halt”) to specify that the system should be completely shut down and the processor halted. When you halt the system, all processes are killed, and the sync command is called to write the memory-resident disk buffers to disk, after which the CPU is halted.



If you truly want the power to be turned off with the shutdown command, press the power switch on the server. The shutdown `-h` command only kills processes and halts the CPU — but the power remains on.

The third state is when the system is being rebooted. The shutdown `-r` command (`-r` meaning “reboot”) accomplishes a reboot. If you are in text mode instead of a GUI (not a virtual console), press Ctrl+Alt+Del. On an MS-DOS computer, this would reboot with any running applications still active and files still open, possibly damaging the system or data. A Linux computer will close files and kill services and applications before rebooting.



You can log out, reboot, or halt from any of the GUI interfaces such as GNOME using the Start style button in the lower left of the screen — select Logout and make your choice (see Figure 8-7).



Figure 8-7 Choose to logout, halt, or reboot the Linux server

Once a system is brought up to **multi-user mode** (meaning the server and its resources are available to network clients), it is common for the system to run for many days, possibly even months, without being shut down or rebooted.

8

OS/2

OS/2 is an operating system for personal computers developed originally by Microsoft and IBM, but sold and managed exclusively by IBM. OS/2 is compatible with DOS and Windows; therefore, it can run most DOS and Windows programs in addition to native OS/2 applications. OS/2 is known for rock-solid performance and reliability on high-end server platforms, which is one reason why it is favored in many banking and financial institutions. In fact, it is likely that when you use an ATM bank card, an OS/2 server actually performs the transaction. Also, OS/2 is the preferred platform for IBM's Lotus Notes email application.

Despite its strengths, OS/2's Presentation Manager interface is showing its age when compared to the Windows NT/2000 desktop, and IBM's marketing department doesn't appear to be addressing the issue as Windows 2000 outsells all other NOSs today. As a result, existing OS/2 markets are starting to slip and IBM is having difficulty breaking into new markets. Many speculate about IBM's support of OS/2 although IBM asserts that it stands firmly behind the product now and for the future.



OS/2 is available as a workstation product (OS/2 Warp 4), a server product (Warp Server 4), and an e-commerce server product (OS/2 Warp Server for E-business). Unless otherwise specified, the remainder of this book refers only to the server products collectively as "OS/2."

OS/2 has many outstanding characteristics as follows:

- It is very flexible. You can connect to most any type of server, including all of IBM's other servers (AS/400, for example), NetWare, and Windows NT/2000. Moreover, you can connect an OS/2 domain to an NT domain transparently — users can access resources across both platforms without additional logons.
- The **Journalled File System (JFS)** of OS/2 Warp Server for E-business provides astonishing file system stability. JFS keeps a journal of file writes and, in the event of corruption, can restore data in a matter of minutes or seconds, usually transparently to users. If the system must be rebooted, OS/2 plays back the journal, immediately recovering all the data. Also, JFS increases the maximum file size from 2 GB to 2 TB.
- The **Logical Volume Manager (LVM)** feature allows you to span a single partition across multiple physical disks, and partitions can increase in size without reformatting. You can also add or move hard drives without altering the drive letter.
- The OS/2 TCP/IP stack is very robust and capable (supporting up to 64,000 concurrent sockets), offers improved buffer management, is optimized for HTTP connections, and the FTP and TFTP utilities are now multithreaded applications.
- OS/2 supports up to 64 processors out of the box—server vendors do not need to develop specialized drivers to enable this support.
- OS/2 supports **Dynamic DNS**, the ability to accept name registrations from DHCP clients automatically. (Otherwise, somebody has to manually enter all the records and remove or change outdated records.)
- Its advanced printing capability allows printing PostScript files to non-PostScript printers.
- Built-in alerts warn administrators in advance of hardware problems such as low disk space or exceeding a CPU threshold.

Versions

OS/2 versions are OS/2 LAN Server 1.0, 1.2, 1.3, 2.0, 3.0, 4.0, Warp Server 4, and Warp Server 4 for E-business. You are likely to see only a version of Warp 4 in today's servers.

OS/2 Minimum Hardware Requirements

The hardware requirements for OS/2 vary depending on the specific version of OS/2 Warp Server installed and the applications you wish to run on the machine. Here are the minimum requirements for OS/2 Warp Server for E-business:

- Intel-compatible 133 MHz processor or better

- 64 MB of RAM
- 120 MB of hard disk space for base operating system, or 200 MB for the operating system plus all default components

To ensure that your hardware is compatible with OS/2, search for IBM's Device Driver Pack at www.software.ibm.com/os/warp/support.

Installing OS/2

To install OS/2 Warp Server for E-business:

1. Insert the bootable CD-ROM and boot the server. If the server is not compatible with El Torito, create a set of three boot floppy disks using the CDINST utility located on the included Server Pak CD-ROM. Booting from these disks will allow access to most CD-ROMs.
2. The OS/2 CD scans the system, looking for the number of processors installed in the system. Also, a conversion utility automatically marks any existing volumes for conversion to the new LVM partitioning scheme.



OS/2 no longer uses FDISK to manage partitions; instead, the LVM utility performs partitioning functions.

3. Upon reboot, use LVM to specify the partition on which you want to install OS/2. Set the partition as installable and press F3 to exit the LVM utility, saving changes when you exit.
4. Formatting options appear. For a clean install, choose to format using a long format (similar to an MS-DOS unconditional format). This formatting process can take several minutes depending on the size of the volume. However, it marks bad blocks on the disk so that data is not saved there.
5. Upon reboot into a GUI, a panel appears from which you can confirm detected hardware or make changes as necessary. From this GUI, you will select locale, keyboard, mouse, CD-ROM, printers, SCSI adapters, power management, and so forth (see Figure 8-8).
6. Select the services you want to install (see Figure 8-9) and proceed through the interface to select the file system options you want (HPFS and/or JFS).
7. After a reboot, you must select the LAN server components, again using a GUI. These components include the TCP/IP configuration, file and print sharing services, remote access capabilities, and so forth.
8. Finish the installation, and OS/2 is ready to boot into production.

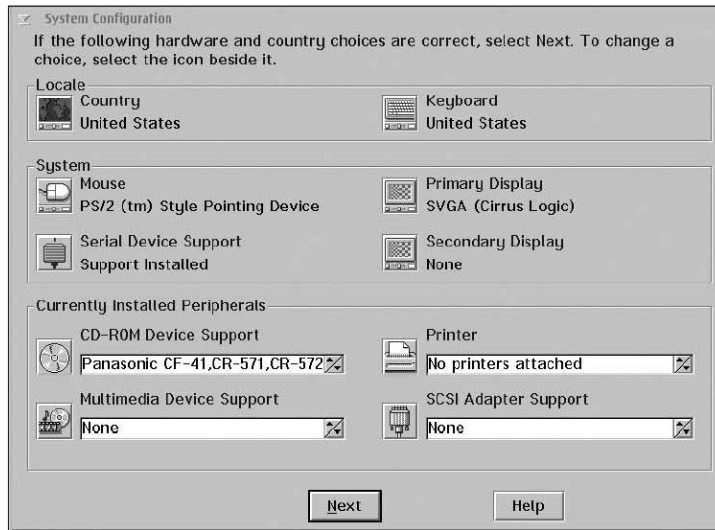


Figure 8-8 Change the OS/2 system configuration as necessary

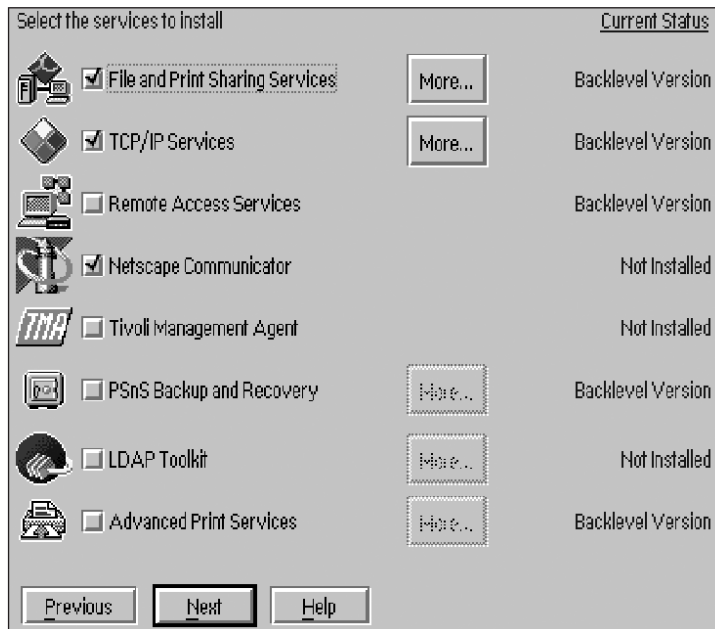


Figure 8-9 Choose from a list of available OS/2 server services

Performing an Upgrade to OS/2 Warp

Upgrading OS/2 is a process much like the installation described, except that previous settings from the OS/2 installation are preserved. During the upgrade, you can choose to migrate existing configuration files to the Config.sys and Autoexec.bat files. Because these files are much more complex under OS/2 than in most Microsoft MS-DOS/Windows installations, you might want to keep these settings to avoid reconfiguring the files from scratch. Near the end of the upgrade (which IBM refers to as a “migration”), a comparison panel appears that allows you to compare the previous configuration file to the new configuration file. You can edit the new configuration as necessary.



For existing servers, run the CHKINST utility that comes with OS/2 Warp Server to check your installation and generate a log file report of steps you should take before performing setup.



Run the PREPMNT utility to upgrade disk drivers (if necessary) prior to upgrading to OS/2 Warp Server.

Creating OS/2 Swap-File Space

A swap file is used in OS/2 as in most other operating systems. Configure the swap file by adding a line to the startup file, Config.sys, as follows:

```
SWAPPATH=<DriveLetter and Path> InitialSize MaximumSize
```

For example, to configure a swap file on drive C with an initial size of 8 MB and a maximum size of 20 MB, you would enter:

```
SWAPPATH=C: \OS2\SYSTEM 8192 2048
```

The swap file is stored by default in the \OS2\SYSTEM directory and is named Swapper.dat.

Performing a Proper OS/2 Shutdown

To shut down OS/2, right-click anywhere on the Warp 4 desktop, and select Shut down from the menu. You can also lock the computer (which requires user credentials to unlock), or log off the network.



IBM's www.redbooks.ibm.com site is a very well-documented source of OS/2 information.

WINDOWS NT SERVER

Organizations currently using Windows NT Server primarily use Windows NT 4.0. Though you might occasionally find version 3.51, this book focuses on NT 4.0 to be current with most environments and because what is true of NT 4.0 is also true of NT 3.51 for our purposes.



The original version of Windows NT was scheduled as a cooperative effort with IBM and was supposed to be another version of OS/2.

Windows NT 4.0 offers the following operating system characteristics:

- A Windows 95-based interface makes it easy to locate administrative tools and applications, and makes it easier to operate compared to command-line-based operating systems (such as the earlier versions of NetWare and Linux).
- The interface and architecture make Windows NT capable of running local user applications—word processors, spreadsheets, even a game of Solitaire if nobody's looking. Other network operating systems, such as earlier versions of NetWare, are not designed for local application support.



Even though you can install user applications on a server, it is better to avoid this. Fewer applications mean less overhead in terms of memory, processor, and hard disk utilization, freeing those resources for true server functions. Also, using an application on a local server requires you to log on, and this is not prudent for most production servers because of the security risk involved if a passerby accesses your logged-on server while you are away from the server.

- Windows NT supports all the major TCP/IP services necessary for an IP network, including DNS, DHCP, and even a basic routing facility, though software routing cannot usually compare to a true hardware router.
- The architecture of Windows is such that it allows a simple user interface while simultaneously limiting what the user can do. Even Windows NT 4.0 Workstation does not allow users to make major changes to the system (such as installing applications). This significantly reduces the administrators support burden, because user-installed applications often adversely affect the stability of the operating system.
- Windows NT introduces domains to the network. A Windows NT **domain** is different than an Internet domain (which is the hierarchical naming facility of the Internet) and is mostly implemented as a security boundary. For example, users in Domain A can access resources in Domain A. If the organization also has a Domain B, users in Domain A cannot cross domains to access resources unless administrators specifically create a trust relationship between the two domains.

- The NTFS file system is Microsoft's first effort at securing hard disk resources, and especially for a first effort, they did a great job. Only persons to whom permission is granted can access a given file or folder. (See more on NTFS in Chapter 5.)
- Windows NT supports multiple protocols, including NetBEUI, IPX/SPX, and TCP/IP.

Windows NT Server 4.0 Minimum Hardware Requirements

Windows NT Server 4.0 has fairly high hardware requirements compared to NetWare 3.x and 4.x, Windows NT 4.0's primary competition at its introduction in 1996. However, at current levels of commonly available hardware, the requirements should not be difficult to match or exceed. The minimum system hardware requirements are as follows:

- Intel-compatible 486/25 MHz processor
- 16 MB of RAM
- 124 MB of hard disk space



Each NOS lists minimum hardware requirements that are well below what you would actually want in a production environment, but the NT minimums are probably the least realistic.

Access the Hardware Compatibility List (HCL) from the Microsoft web site at www.microsoft.com/hcl.

Installing Windows NT 4.0 Server

Installing Windows NT 4.0 Server is a fairly straightforward process. First, you must find a way to access the CD-ROM. The easiest way is to configure the BIOS settings in an El Torito-compatible system that can automatically access and boot from the CD-ROM. If your system is not El Torito-compatible, you can use the three floppy disks in the Windows NT boxed set. Boot from the first floppy and change disks when prompted. These disks also load CD-ROM drivers so that you can access the source files on CD-ROM. Finally and as a last resort, use any MS-DOS system boot floppy (such as a Windows 98 startup disk) that also loads your CD-ROM drivers.

Though you can launch setup after booting from a Windows 98 startup disk, it has several drawbacks. Windows NT does not recognize FAT32 partitions, so if you use a Windows 98 startup disk to create partitions, be sure to answer "N" (no) at the FDISK prompt to enable large disk support, which causes partitions to be formatted for FAT32. Otherwise, Windows NT will not be able to locate a suitable partition in which to copy installation files. Also, booting from a Windows 98 startup disk "locks" the hard drive, which means that the Windows NT installation will not be able to copy files to it. If you use a Windows 98 startup disk, type "lock c:" at a command prompt to remedy this

situation. Also, there must be an existing FAT partition of at least 123 MB to store setup files. These drawbacks make booting from the Windows 98 floppy the least attractive choice, but it will do if necessary.

1. After booting from the CD-ROM or NT boot floppies, setup begins automatically, and you can skip to Step 4. If booting from a boot floppy with CD-ROM drivers, change to the CD-ROM drive (we'll assume it's drive D).



Installation proceeds much faster with both Windows NT and Windows 2000 if you first copy the Smart Drive executable to the boot floppy. Smart Drive caches read from the CD-ROM. At the MS-DOS prompt, simply type SMARTDRV to load Smart Drive. This only applies to installations that use a manually configured MS-DOS or Windows 98 boot floppy because the Windows NT boot floppy and bootable CD-ROM automatically load caching.

2. Go to the \i386 directory. This is the directory used for installing NT to an Intel-based PC server. However, you can also install Windows NT on a PowerPC, MIPS, or Alpha-processor-based server.
3. Type *winnt /b* and press Enter. This initiates the text mode portion of setup, which starts by copying setup files to the local hard disk (see Figure 8-10).

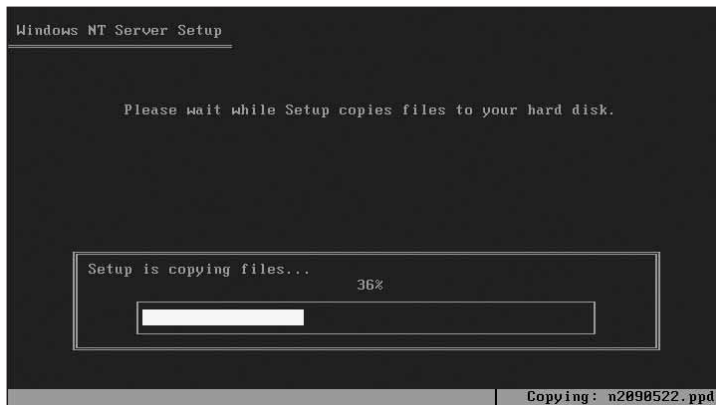


Figure 8-10 The Windows NT 4.0 file copy stage of text mode setup



The *"/b"* prevents manual creation of the three boot floppy disks, which can also be created after installation by typing *winnt /ox* from a command line in Windows NT. These disks are duplicates of the floppies included in the NT box and are useful for accessing the CD-ROM to start setup and for repairing an ailing NT installation.

4. Proceed through the setup process, following the prompts. You are prompted to specify any additional storage devices such as SCSI cards that might not have been detected by setup (see Figure 8-11). If so, supply the drivers from a floppy disk. (If you booted from a generic floppy, a reboot occurs between Step 3 and 4).



Figure 8-11 Add additional drivers for devices not detected by setup

5. Basic hardware detection finds hardware such as keyboard, mouse, and display adapters. This level of device detection is very basic; a more in-depth and accurate detection occurs closer to the end of the setup process (see Figure 8-12).

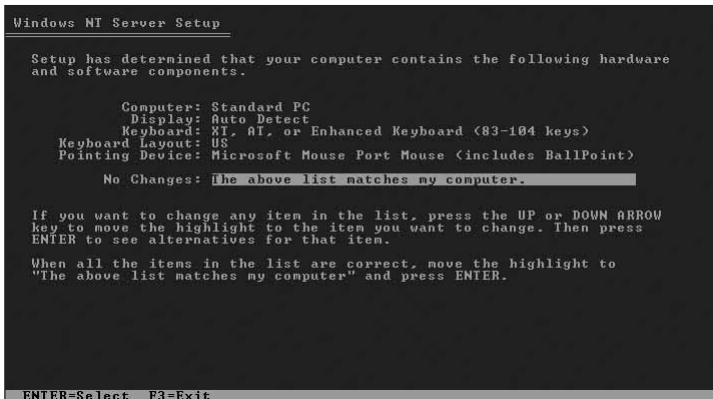


Figure 8-12 Basic device detection as determined by Windows NT 4.0

6. Select a partition in which to install the operating system. If none of the existing partitions suit you, you can delete or create other partitions. Assuming that you started with a FAT partition, setup offers you the chance to convert to an NTFS partition. For sake of performance and security, it is normally best to choose the NTFS conversion at this point (see Figure 8-13).

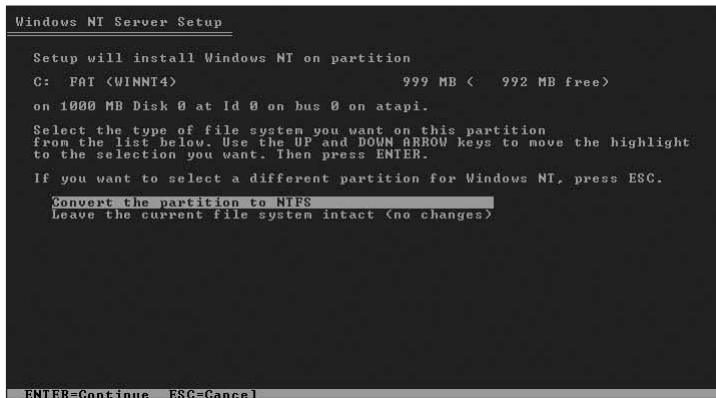


Figure 8-13 Convert partitions to NTFS



You can also convert from FAT to NTFS after NT is installed, except that this conversion does not apply security permissions to certain sensitive system directories for Windows NT. Use the C2 Configuration utility included in the Windows NT 4.0 Resource Kit to automatically reset default permissions. If you convert to NTFS during setup, however, default security permissions are applied.

7. Setup copies more files to the hard disk. When prompted, press Enter to reboot the system. If you opted to convert from FAT to NTFS, the conversion takes place. This concludes the text portion of the setup process. The graphical portion begins after the reboot.
8. Enter your name and organization.



The name you enter here is the name of the person legally liable for properly licensing the product. So if at all possible, enter your boss's name.

9. Enter the CD Key that accompanied the product.
10. Select a licensing mode (see Figure 8-14):
 - **Per server:** Enter the number of concurrent connections allowed under the licensing scheme you purchased. Choose this method if clients will usually connect to only one server. If you have 100 users connecting to four servers, then each server would require 100 licenses—a total of 400. This would not be cost-effective.
 - **Per seat:** Each client that connects to this server must be properly licensed. This is much more cost-effective than the per-server licensing scheme if clients connect to multiple servers. Continuing the earlier example, a per-seat licensing solution would require only 100 client licenses,

one for each user workstation regardless of the number of servers to which the client connects. You can convert from per server to per seat, and money spent on per-server licensing can be directly applied to the new per-seat licensing scheme. Conversion is a one-time, one-way event. You cannot convert from per seat back to per server.

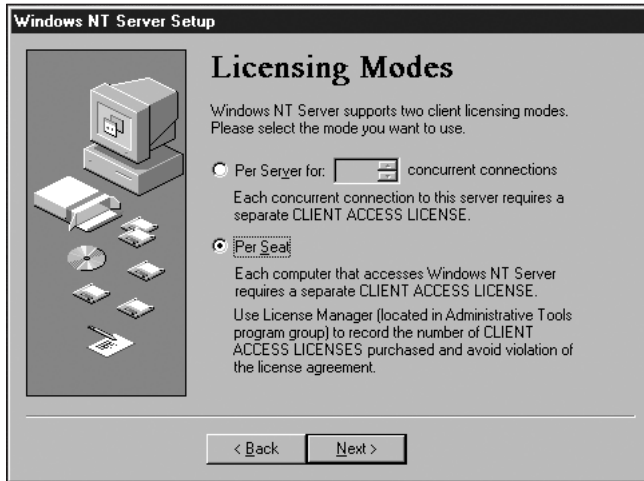


Figure 8-14 Select the per-server or per-seat licensing mode

11. Enter a computer name. This name is how the server is identified and must be unique within the network.
12. Choose the role of this NT server (see Figure 8-15):
 - **Primary Domain Controller (PDC)** — Stores the only read/write copy of the directory database. This database is a record of user and computer accounts, and is used for logging on users.
 - **Backup Domain Controller (BDC)** — Stores a read-only copy of the directory database, and is useful as an extension to the PDC for logging on users and computers. You must have a PDC before you can have a BDC.
 - **Stand-alone Server** — Does not store the directory database and is not a member of the domain. This type of server does not share users or groups from the domain controller, but is useful for other resources and services for which users do not require direct access (for example, a web server allowing anonymous access or a DNS server).
 - **Member Server** — Is a member of the domain but does not contain a copy of the directory database. Because it is a member of the domain, administrators can configure access permissions to its resources using domain user and group accounts. To configure a member server, you install it as a Stand-alone server, and later join it to the domain. A member server can be useful as a file, print, or application server, or provide one or more services (see Chapter 9).

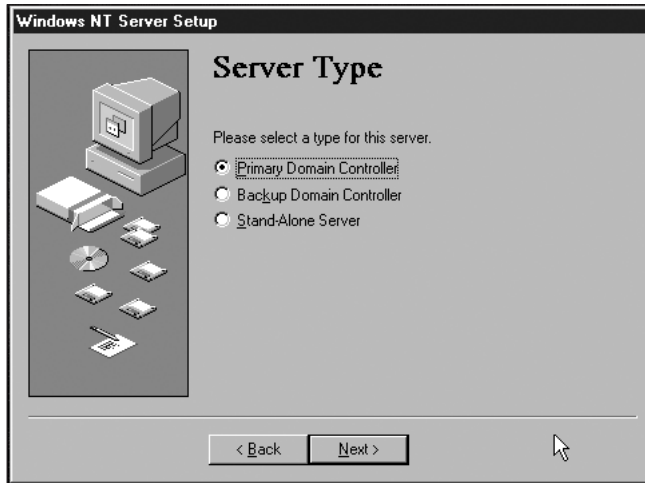


Figure 8-15 Select a role for the server

13. Continue through the installation, answering prompts and choosing installation options. You will enter a password for the local Administrator account (don't forget it) and install a network adapter if one is not detected automatically.



If you experience difficulty installing the network card at this point but want to proceed with the installation, choose the MS Loopback Adapter, which is a software trick allowing you to install networking components without an actual physical network adapter.

14. When finished with all the setup prompts, the system boots to the standard Windows NT 4.0 desktop.

Upgrading to Windows NT 4.0 Server

To initiate the upgrade, just insert the Windows NT 4.0 Server CD into the CD-ROM drive. A prompt appears to automatically begin installation or you can run `Winnt32.exe` from the `\i386` directory. Despite Microsoft's own success in upgrades, I still recommend a clean install whenever possible, because an upgraded system can inherit remnant bugs or files that are not used in Windows NT 4.0.



`Winnt.exe` executes the Windows NT/2000 setup process from MS-DOS. From within existing Windows operating systems that you want to upgrade, use `Winnt32.exe`.

Creating Windows NT 4.0 Swap-File Space

Windows automatically creates its own swap file as part of installation. Typically, the swap-file defaults are of acceptable size, though you might want to change the drive on which the paging file appears for performance reasons (see Chapter 11).

To modify **paging file** configuration (as it is called in NT 4.0/Windows 2000):

1. Right-click My Computer on the desktop (or double-click the System icon in Control Panel).
2. Select Properties from the menu.
3. Click the Performance tab, and then click the Change button in the middle of the dialog box (see Figure 8-16).
4. Specify the drive, initial size, and maximum size. Remember to click the Set button after configuring the paging file.
5. Click OK twice.
6. Reboot the system.

8

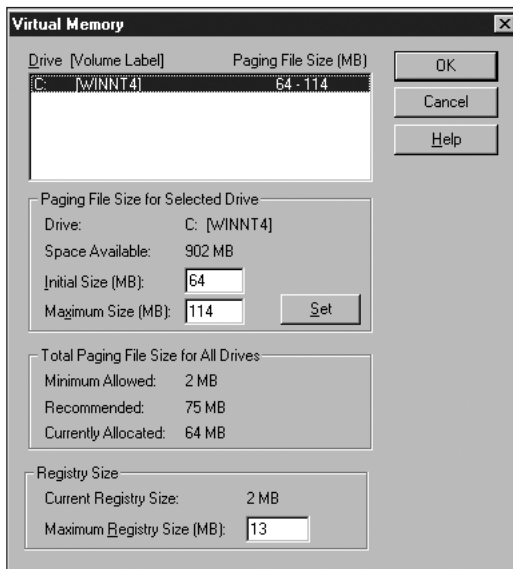


Figure 8-16 Adjusting the virtual memory paging file

Performing a Proper Windows NT 4.0 Shutdown

Shutting down any Windows operating system is very easy. Simply click Start, click Shut Down, and select from a list of options to shut down the computer, restart the computer, or close all programs and log on as a different user (see Figure 8-17). When the

computer is “shut down,” you must still turn off the power, or you can click a Restart button if you change your mind and want to reboot the operating system.

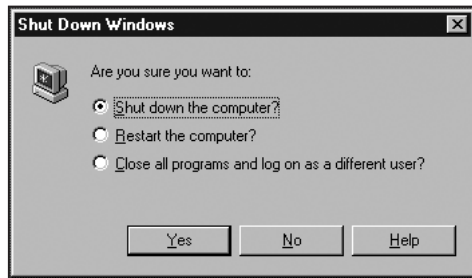


Figure 8-17 Choose to shut down, restart, or log off

WINDOWS 2000

The Windows 2000 operating system family from Microsoft provides a significant advancement in features, stability, and increased runtime over its venerable NT predecessor. Although we will continue to see Windows NT 4.0 on servers everywhere for a few more years, Windows 2000 looks poised to eclipse NT 4.0 in many organizations.

The characteristics of Windows 2000 are as follows:

- The primary characteristic of Windows 2000 is arguably its new directory service, known as Active Directory. **Active Directory** is a comprehensive database capable of storing millions of objects such as users, groups, computers, and more. In terms of functionality, Active Directory users can log on and access resources anywhere in the enterprise regardless of geographic location or where the user account was originally created.
- Active Directory domains evolved from the original Windows NT 4.0 domains. Whereas under Windows NT an organization might have multiple domains in a flat namespace such as Domain A, Domain B, and Domain C, Active Directory uses a DNS hierarchy such as DomainA.DomainB.DomainC. Also, Active Directory provides a structure allowing administrators to consolidate all NT 4.0 domains into a single domain.



NetWare administrators will notice some similarities between the tree structure of NetWare 4.x and later and Windows 2000 Active Directory. This is because both operating systems use the LDAP standard.

- In the past, Microsoft environments have relied heavily on WINS as the name resolution service for Microsoft network NetBIOS hosts. Windows 2000 allows the administrator to shed the need for WINS because DHCP clients can automatically register themselves in the DNS database using Dynamic DNS. In the

past, someone would have to manually enter DNS registrations. However, Windows 2000 still offers the WINS service to support NetBIOS clients.

- Windows 2000 offers strong **scalability** (the ability to grow in terms of the number of processors) in that you can use 4, 8, or even 32 or more processors in a single SMP system. To be fair, I should emphasize that all NOSs in this chapter support SMP. Microsoft claims to have an extremely efficient architecture that allows SMP systems to obtain a high level of performance.
- Up to 8 GB of memory support allows Windows 2000 Advanced Server to handle large and demanding files and applications.
- No other operating system offers as much broad hardware compatibility support, thanks to true Plug and Play capabilities.
- Built-in clustering support in Windows 2000 Advanced Server and Windows 2000 Datacenter Server allows a server in a cluster to fail or be removed for routine maintenance while remaining members of the cluster continue to provide service.
- Windows file protection prevents new software installations from replacing critical Windows 2000 system files. This makes Windows 2000 more stable than past Windows versions. Also, Microsoft has instituted a thorough testing process for hardware manufacturers, in which their drivers must be proven safe and stable under Windows 2000. If a driver passes Microsoft's tests, a validating certificate is attached to the drivers.
- Administrators were frequently aggravated when a seemingly minor change to Windows NT 4.0 required a reboot before the change could take effect. Microsoft greatly reduced the number of events for which you have to reboot the system in Windows 2000. For example, you can change the IP address on a running system, and the change takes place after a few seconds without a reboot.

Versions

Windows 2000 comes in the following versions:

- *Windows 2000 Professional.* Though not a server operating system, this is the ideal client for Windows 2000 servers, especially for purposes of centralized administration and automated software distribution. Windows 2000 Professional supports up to 4 GB of RAM and 2-way SMP.
- *Windows 2000 Server.* The core server product capable of 4 GB of RAM and 4-way SMP.
- *Windows 2000 Advanced Server.* Windows 2000 Server plus support for clustering, up to 8 GB of RAM, and 8-way SMP.
- *Windows 2000 Datacenter Server.* Windows 2000 Advanced Server plus support for up to 64 GB of RAM and 32-way SMP.



Windows XP is the desktop successor to Windows 2000 Professional but has mostly the same platform and architecture, and is designed to finally replace the Windows 9.x architecture. Windows .NET is the upgrade to Windows 2000 Server.

Windows 2000 Minimum Hardware Requirements

Windows 2000 Server lists somewhat more realistic minimum hardware requirements than Windows NT 4.0 Server; however, you should still obtain server equipment that is as capable as prudently possible. Minimum system hardware requirements are as follows for Windows 2000 Server and Windows 2000 Advanced Server:

- Intel-compatible 133 MHz processor or higher. (Windows 2000 Datacenter Server requires the same minimum hardware, except that the processors must be Pentium III Xeon or higher)
- 128 MB of RAM, though Microsoft strongly recommends at least 256 MB
- 2 GB hard disk with 1 GB of free space

You can verify the compatibility of specific hardware by visiting the Microsoft web site at www.microsoft.com/hcl.



You cannot purchase Windows 2000 Datacenter Server off the shelf and install it wherever you like. Instead, only system integrators can purchase the product and sell it preinstalled with the server.

Installing Windows 2000 Server

The general steps for installing Windows 2000 are very similar to Windows NT 4.0:

1. After booting from the CD-ROM, setup begins automatically, and you can skip to Step 4. If booting from a boot floppy with CD-ROM drivers, change to the CD-ROM drive (we'll assume it's drive D).
2. Go to the \i386 directory. This is the directory used for installing NT to an Intel-based PC server. Windows 2000 only installs on Intel-based processors.
3. Type *winnt* and press Enter. This initiates the text mode portion of setup. Windows 2000 does not create the boot floppies by default; so the */b* option is not necessary, as it was for NT 4.0.
4. Proceed through the setup process, following the prompts such as license agreement, partitioning, and additional storage devices (for example, SCSI adapters) that might not have been detected by setup. If so, supply the drivers from a floppy disk. (If you booted from a generic DOS floppy, a reboot occurs between Step 3 and 4.)
5. Basic hardware detection finds hardware such as keyboard, mouse, and display adapters. This level of device detection is very basic; a more in-depth and accurate detection occurs closer to the end of the setup process.

6. Select a partition in which to install the operating system. If none of the existing partitions suit you, you can delete or create other partitions. Assuming that you started with a FAT partition, setup offers you the chance to convert to an NTFS partition. For sake of performance and security, it is normally best to choose the NTFS conversion at this point.



You can also convert from FAT to NTFS after installation. A Windows 2000 server automatically applies security permissions appropriately when converted to NTFS.

7. Setup copies more files to the hard disk. When prompted, press Enter to reboot the system. If you opted to convert from FAT to NTFS, the conversion takes place. This concludes the text portion of the setup process. The graphical portion begins after the reboot.
8. Confirm the locale and keyboard settings, and then enter your name and organization.
9. Select a licensing mode under the same guidelines discussed in the Windows NT 4.0 section.
10. Enter a computer name. This name is how the server is identified and must be unique within the network. Then enter the password for the Administrator account.
11. Continue through the installation, answering prompts and choosing installation options.
12. Select typical or custom network settings. Choosing Typical really means that the computer will be configured as a DHCP client. Choosing custom settings exposes the network property sheet so that you can manually configure IP settings (see Figure 8-18).
13. Choose to make the computer a member of a workgroup or a domain.

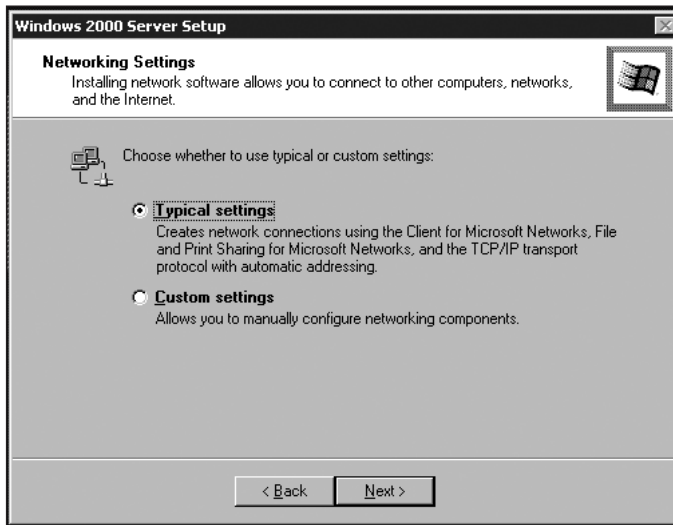


Figure 8-18 Choose Typical for DHCP clients, and Custom for manual IP configuration



In Windows NT 4.0, you would choose the server role during installation. But Windows 2000 servers always install as member servers (member of a domain but not a domain controller) or a stand-alone server (not a member of a domain). After installation, you can make the Windows 2000 server a peer domain controller by running DCPROMO from a command line, which launches a domain controller installation utility. All Windows 2000 domain controllers are peer domain controllers. This means that each domain controller has both a read and write copy of the directory database.

14. When finished with all the setup prompts, more files copy to the hard disk and a prompt requests that you reboot.
15. After the reboot and login, you see the standard Windows 2000 desktop.

Upgrading to Windows 2000 Server

You can upgrade a Windows NT 3.51 server or Windows NT 4.0 server to Windows 2000 Server. You cannot upgrade any desktop client operating system to Windows 2000 Server. The easiest way to upgrade to Windows 2000 is to simply insert the CD and allow Autoplay to start setup. If Autoplay is disabled, you can run Winnt32.exe from the \i386 directory. A prompt asks whether you want to perform an upgrade or clean install (see Figure 8-19).



Figure 8-19 Select an upgrade or clean install

Creating Windows 2000 Swap-File Space

As with most Windows installations, Windows 2000 automatically configures a swap file for virtual memory use. You can adjust the size, move, or split the paging file among available drives using the System Properties as follows:

1. Right-click My Computer and click Properties (or select System from the Control Panel). The System Properties dialog box opens.
2. Click the Advanced tab and select the Performance Options button.
3. In the Performance Options dialog box, click the Change button.
4. The dialog box that appears next is nearly identical to the Windows NT 4.0 Virtual Memory dialog box (refer to Figure 8-16). Enter the size of the swap file, click Set, and then click OK. Adjusting the swap file is one of the few reboot events in Windows 2000.

Performing a Proper Windows 2000 Shutdown

Shut down a Windows 2000 server similarly to a Windows NT 4.0 server. Click Start, click Shut Down, and select your shutdown option (see Figure 8-20). Windows 2000 has better power management than Windows NT 4.0, and it is more likely to turn off the power through the operating system. On some systems, you will still press the power button to turn off power to the server—just wait for the message that says it is safe to turn off the server.



Windows 2000 also allows you to place the system in a low-power standby state, or hibernation, which saves the complete contents of RAM to disk. When you turn on the power again, the contents on disk are reloaded into RAM; this is faster than a standard startup of the operating system.



Figure 8-20 Windows 2000 allows log off, shut down, restart, stand by, and hibernate

UPDATING A NETWORK OPERATING SYSTEM

There is a slight difference between a patch, fix, and update. However, the differences do not matter for our purposes—I'll collectively call these updates. Inevitably, an operating system requires an update. There are many possible reasons for this, including:

- *Security vulnerability.* These updates usually come out as quickly as possible from the vendor. Unless there exists a compelling reason to avoid it, you should nearly always apply security updates for obvious reasons.
- *Incompatibility.* Even after rigorous testing, an operating system is likely to encounter compatibility problems with some number of applications. How quickly an update is released depends on the severity of the problem.
- *Poor functionality.* An operating system simply doesn't function as promised, and requires an update to fix the problem.
- *Added features.* Prior to the release of the next major version of an operating system, a vendor might release additional features for free. For example, Microsoft released the Option Pack for Windows NT 4.0, which improved NT 4.0's Internet server features.

Regardless of the reason for an update, you should regularly check with the manufacturer of your operating system to see if there are any updates available that might be useful to you. In the server context, I discourage applying updates just because one exists. While an update might be designed to fix one problem, it might accidentally create some other problem or incompatibility. At the least, you should thoroughly test updates before placing them into production.

To help you keep abreast of important updates, some vendors send you email when one is released. With Windows 2000, Windows Critical Update Notification periodically checks the Microsoft web site to see if a new update is available and notifies you of the update with a visual indicator. The Windows Update site scans your system and offers updates available for your system. You check off the upgrade items you want and apply the updates over the Internet (see Figure 8-21), simplifying the more cumbersome process in Windows NT 4.0 in which you have to download an update, extract the files to a temporary location, and run the update.

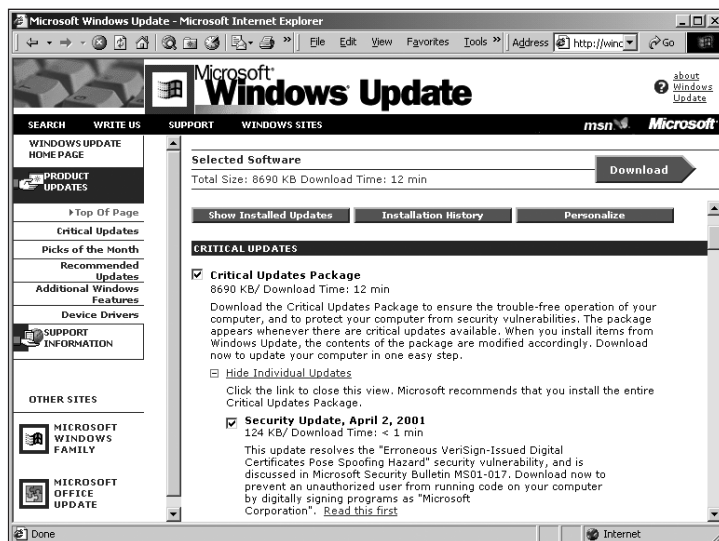


Figure 8-21 The Windows Update site automatically scans your system and notifies you of updates available for your system

Not all updates install with the same procedures—the best practice is to read the web site documentation that describes the update to find out how to apply it. For example, Red Hat site updates have an encrypted authentication that you decrypt to verify that the update is truly a Red Hat update and not from a malicious source.

CHAPTER SUMMARY

- A production server will quickly languish in attempting to provide service to the network with only the vendor's recommended minimum hardware. Preparing server hardware for NOS installation involves the right perspective. Instead of trying to get away with as little as possible, the administrator's perspective should be nearly the opposite: obtain hardware that is reasonably powerful enough for current and future requirements.

- The process of translating virtual addresses into real addresses is called mapping. Copying virtual pages from disk to main memory is known as paging or swapping. Swapping is a useful technique that enables a computer to execute programs and manipulate data files larger than main memory.
- Novell NetWare is a widely accepted LAN operating system developed by Novell Corporation. NetWare runs on a variety of different LANs, including Ethernet and IBM Token Ring. NetWare offers users and programmers a reliable interface that is independent of the underlying hardware that transmits data. Depending on the version, NetWare uses either a bindery or directory service design to manage the majority of network resources. NetWare 3.x uses a bindery, but NetWare 4.11 and later versions use NDS.
- NetWare offers very capable web and application server technologies, a GUI known as ConsoleOne, the ZENworks network management tool, and flexible TCP/IP IPX/SPX options.
- Install NetWare on at least a server-class PC with a Pentium II or higher processor, a DOS partition between 30 and 100 MB, and at least 1.3 GB disk space on the SYS volume beyond the DOS partition for the standard NetWare products and WebSphere Application Server for NetWare. Also include at least 128 MB of RAM for the standard NetWare components.
- Use a network card that is automatically detected by the NetWare installation. Otherwise, you must specify the make and model of the network card from a list or provide the drivers from a floppy. Automatically detected NICs usually do not require you to manually specify resources.
- Decide which version of NDS you will use. NetWare 5.1 allows you to use either NDS 8 (default) or NDS 7. NDS 8 provides the enhanced NDS functionality needed by many new web networking products, such as WebSphere.
- The first volume NetWare creates is called the SYS volume, and Novell recommends you make it at least 200 MB (a complete install with all documentation requires about 600 MB). The SYS volume should be used for only NetWare system files and NetWare Loadable Modules (NLMs; NetWare programs and applications)—not user data.
- It is not advisable to use only the SYS volume for swap files, because this volume is typically already very busy. Instead, you should place one or more swap files on other high-performance volumes with plenty of free space. Create or manage swap-file space with the SWAP ADD command.
- To shut down a NetWare server, enter *down* at a command prompt to close all services and files. A handy feature of NetWare is that in this process, a notification of the downed server is delivered to all attached workstations. If you would rather just reboot the server, enter *restart server*.

- ❑ UNIX has been a popular choice among universities and corporations because of its low cost and the fact that programmers familiar with the C high-level programming language can modify the code to specific requirements. UNIX has split into two main dialects: AT&T's System V and the University of California, Berkeley version known as BSD 4.1, 4.2, or 4.3. Within the two main versions, there are dozens of other modified versions ("flavors").
- ❑ Linux is a version of UNIX that, like other flavors, is open source code. Linus Torvalds authored early versions of Linux with the objective of creating a relatively small UNIX source code that would run on Intel-compatible computers (as opposed to the CISC-based processors of other UNIX versions). Several vendors offer Linux in boxed sets.
- ❑ A Linux installation requires at least an Intel-compatible 80386 processor or higher, 32 MB of RAM, and 500 MB of hard disk space.
- ❑ The Linux installation is best launched from CD-ROM. You can use the Disk Druid utility to manage the hard disk partitions. You will need at least a root partition, swap partition, and boot partition.
- ❑ You can shut Linux down to single user mode (where all users are disconnected and files are closed), a halt state, or you can reboot the server.
- ❑ Linux offers GUI interfaces that make administration much simpler than the text-only command line interface of UNIX/Linux.
- ❑ OS/2 is known for rock-solid performance and reliability on high-end server platforms, which is one reason why it is favored in many banking and financial institutions, and also offers support for up to 64 processors. OS/2 offers the Journaled File System (JFS) for data integrity and Logical Volume Manager (LVM) for very flexible partition and disk management.
- ❑ The OS/2 installation requires at least an Intel-compatible 133 MHz processor, 64 MB of RAM, and 120 MB of hard disk space for the base operating system, or 200 MB for the operating system plus all default additional components.
- ❑ When upgrading to OS/2 Warp Server, it is usually best to migrate existing configuration files (Autoexec.bat and Config.sys) to avoid reconfiguring the files from scratch.
- ❑ Create an OS/2 swap file by using the SWAPPATH syntax:
SWAPPATH=<DriveLetter and Path> *InitialSize MaximumSize*.
- ❑ You can shut down the OS/2 operating system by right-clicking anywhere on the Warp 4 desktop and choosing Shut Down from the menu. You can also lock the computer (which requires user credentials to unlock) or log off the network.
- ❑ The Windows NT operating system has a Windows 95-based interface and allows you to run local user applications, and introduces a security boundary known as an NT domain, which is not the same as a DNS domain.

- ❑ Windows NT requires at least an Intel-compatible 486/25 MHz processor, 16 MB of RAM, and 160 MB of hard disk space. You can verify compatibility of hardware devices at www.microsoft.com/hcl.
- ❑ You can boot to a Windows 98 floppy to start a Windows NT installation, but it can cause compatibility problems with FAT32 partitions and lock the hard drive. You can convert the FAT file system to NTFS either during or after the installation.
- ❑ Windows NT licensing modes can be either per server or per seat. You can install the server as a Primary Domain Controller (PDC), Backup Domain Controller (BDC), member server, or stand-alone server.
- ❑ Create the Windows NT or Windows 2000 paging file using the System properties of the server. To shut down Windows NT or Windows 2000, click Start, and then click Shut Down.
- ❑ Windows 2000 introduces its LDAP directory service, Active Directory, which can store several types of objects and uses the DNS hierarchical namespace. Dynamic DNS services allow clients to self-register their host names.
- ❑ The Windows 2000 installation requires an Intel-compatible 133 MHz or higher processor (Xeon III or better for Datacenter Server), 128 MB of RAM, and 2 GB of hard disk space with 1 GB of free disk space.
- ❑ You will periodically have to update the operating system for reasons of security, incompatibility, poor functionality, or added features. Each NOS specifies a different method for installing updates, but the vendor download sites should provide specific instructions.

KEY TERMS

Active Directory — Microsoft's LDAP directory service for Windows 2000 that is a comprehensive database capable of storing millions of objects such as users, groups, computers, and more. In terms of functionality, Active Directory users can log on and access resources anywhere in the enterprise regardless of geographic location and where the user account was originally created.

Backup Domain Controller (BDC) — A Windows NT server that stores a read-only copy of the Primary Domain Controller's (PDC's) directory database, and is useful as an extension to the PDC for logging on users and computers. You must have a PDC before you can have a BDC.

bindery — A NetWare directory of users, groups, and network resources that provides network clients with the information that is stored on the NetWare server's local directory partitions. A bindery is restricted to the computer on which it resides, and users can only use resources managed in the same bindery to which they log on.

ConsoleOne — A central management point for performing NetWare 5.1 administration.

- container** — In Novell NetWare, a general term for an Organization or Organizational Unit, which are hierarchical components of the NDS tree. All network objects must reside in a container in the tree.
- directory service** — A network service that identifies all of the resources on a network and makes them available to applications and users. Resources can include things like email addresses; user, group, and computer accounts; and peripheral devices such as printers.
- Disk Druid** — A Linux disk partitioning utility.
- domain** — In Windows NT or 2000, a security boundary. Not the same as a DNS domain.
- Dynamic DNS** — The ability to accept name registrations from DHCP clients automatically.
- El Torito** — A CD from which you can boot the computer, provided the BIOS supports this feature.
- GNOME** — A GUI for UNIX administration.
- host name (“A”) record** — A DNS entry that resolves a host’s IP address to its host name, allowing users to access a server using the name instead of the IP address.
- hot fix** — A NetWare feature that verifies the integrity of all disk writes, and if a write fails this verification, the data is redirected to a hot fix area and the original destination is marked as unusable. The default size of the hot fix area is a small percentage of a partition’s total size.
- Journaled File System (JFS)** — An OS/2 file system that keeps a journal of file writes and, in the event of a corruption, can restore the data in a matter of minutes or seconds, usually transparently to users.
- Lightweight Directory Access Protocol (LDAP)** — A directory service standard for enabling searches and queries to locate, identify, and utilize resources among networks.
- Linux Loader (LILO)** — A Linux boot management utility that allows you to select from two or more operating systems at boot time.
- Logical Volume Manager (LVM)** — An OS/2 utility that allows you to span a single partition across multiple physical disks, and partitions can increase in size without reformatting. You can also add or move hard drives without altering the drive letter.
- mapping** — In virtual memory, copying virtual pages from disk to main memory.
- member server** — A Windows NT server that is similar to a stand-alone server, but is a member of the domain.
- memory core dump** — Representation of the contents of memory in the event of a problem, also known as simply a “memory dump.”
- mount** — A reference to preparing a Novell NetWare volume for use. You mount or dismount volumes.
- multi-user mode** — The mode in which a Linux/UNIX server and its resources are available to network clients.
- NetWare Loadable Module (NLM)** — Programs that run on a NetWare server. An NLM might include a management utility or server-based applications such as a database engine.

Novell Directory Services (NDS) — A scalable Novell NetWare tree structure representing resource information that extends throughout the enterprise. The administrator can plan and configure the NDS tree so that users from anywhere in the organization can log on and access resources anywhere in the organization without a second logon.

page fault — When the operating system requests a needed page of data or instructions that is not currently in memory.

paging (or swapping) — Copying virtual pages from disk to main memory.

paging file — Microsoft term for a Windows NT 4.0 or Windows 2000 swap file.

partitionless — Using an existing DOS or Windows partition instead of creating a partition manually during installation using FDISK or Red Hat's Disk Druid partitioning tool.

per seat — A licensing scheme that requires each client that connects to the server to have proper licensing.

per server — A licensing scheme that represents the number of concurrent connections allowed under the licensing scheme you purchased.

Primary Domain Controller (PDC) — A Windows NT server that stores the only read/write copy of the directory database. This database is a record of user and computer accounts, and is used for logging on users.

scalability — A server's ability to grow in terms of the number of processors.

single-user mode — In UNIX/Linux, a mode in which user connections are closed, ensuring that there are no locks on open files. This is not a complete shutdown because the operating system is still running.

stand-alone server — A Windows NT server that is not a member of the domain and does not store the directory database, but is useful as a file, print, or application server, or provides one or more services.

virtual console — A separate Linux context to which you can log on and perform various tasks while other virtual consoles or a GUI also run.

virtual memory — A portion of hard disk space that extends RAM memory.

WebSphere — An IBM application for building and managing web-based applications.

X.500 ITU — Originally a standard for searching email directories but has much broader application. The standard is so large and complex that no vendor complies with it completely.

X Term — A text-based terminal interface within the Linux GUI.

X Windows — A GUI for the UNIX administration.

Zero Effort Networks (Z.E.N.) or ZENworks — A NetWare tool that administrators use to manage the user or server operating system environment by automatically distributing applications and controlling the user desktop.

REVIEW QUESTIONS

1. What is the purpose of a swap file?
 - a. to boost the effectiveness of the processor
 - b. to allow processes to alternate between processors in an SMP server
 - c. to transfer data from slower pages in RAM to faster pages in RAM
 - d. to extend the range of physical RAM to virtual memory on the hard disk
2. Which of the following is a widely accepted local area network (LAN) operating system that was developed by Novell Corporation and runs on a variety of different types of LANs, including Ethernet and IBM Token Ring networks?
 - a. NetWorks
 - b. GateWare
 - c. Warp
 - d. NetWare
3. What GUI interface makes managing NetWare more intuitive for the administrator?
 - a. Crayon Manager
 - b. Program Manager
 - c. InterfaceOne
 - d. ConsoleOne
4. How can you simultaneously support both IPX/SPX and TCP/IP on a NetWare network with minimal additional network traffic?
 - a. segment the network into a separate IPX/SPX and TCP/IP network
 - b. install IP with IPX compatibility
 - c. use switches instead of routers
 - d. remove all IPX/SPX applications
5. How can you automatically create swap-file space on one or more NetWare volumes when the operating system boots?
 - a. create a visual basic script
 - b. add the SWAP ADD command to the Autoexec.ncf file
 - c. access the System properties in Control Panel and select the Advanced tab
 - d. You cannot. NetWare does not support swap files.
6. How should you prepare NetWare version 4 for an upgrade to version 5.1?
 - a. No actions are necessary; just insert the 5.1 CD and setup automatically begins.
 - b. Run the NetWare Deployment Manager.
 - c. Uninstall NetWare 4 first, and then install NetWare 5.1.
 - d. First upgrade to NetWare 5.0, then upgrade from 5.0 to 5.1.

7. Which of the following is a network component that identifies resources like email addresses, computers, and peripheral devices on a network and makes them available to applications and users?
 - a. network operating system
 - b. local area network
 - c. redirector
 - d. directory service
8. Which of the following is an interactive time-sharing operating system invented in 1969 by Brian Kernighan and Dennis Ritchie, the inventors of C?
 - a. Linux
 - b. NetWare
 - c. OS/2
 - d. UNIX
9. Which utility do you use in Red Hat Linux 7 to make a boot diskette under MS-DOS?
 - a. rawrite
 - b. dosutils
 - c. dd
 - d. makedisk
10. Linux is free over the Internet and PCs are inexpensive. Why not build your own Linux server?
 - a. A server from a major vendor with Linux preinstalled offers better support and reliability.
 - b. You cannot obtain Linux off the shelf; it must come preinstalled on a server.
 - c. There is no way to do it without violating the Linux licensing agreement.
 - d. Linux does not work with PC servers, only CISC-based processors such as Alpha.
11. Which of the following offers you the chance to boot from multiple operating systems?
 - a. NWLoader.nlm
 - b. LELA
 - c. MultiBoot
 - d. LILO

12. You want to create a partition for swap-file space during the Linux installation. Which partitioning utility should you use?
 - a. FDISK
 - b. JFS
 - c. Disk Druid
 - d. LVM
13. Why would you proceed with caution before installing a Linux server system?
 - a. It requires significantly more system resources than the workstation installation.
 - b. It removes all partitions on all drives.
 - c. It flushes the cache, possibly discarding important data.
 - d. It automatically creates a root volume but no boot volume.
14. To properly shut down Linux:
 - a. hit the power button, and all services and files automatically close
 - b. enter *shutdown -r* and then turn off the power
 - c. enter *shutdown -h* and then turn off the power
 - d. enter *die die die* and turn off the power
15. Why does OS/2 have a loyal following among banks and financial institutions?
 - a. It is completely void of floating point calculation errors.
 - b. It is extremely stable and reliable.
 - c. It is necessary because only OS/2 can load extremely large databases.
 - d. It is free.
16. The Journalized File System (JFS) is:
 - a. a detailed record of bad file writes
 - b. an extremely powerful and flexible tape backup system
 - c. an OS/2 facility that enables nearly immediate recovery of files when a bad write occurs
 - d. an auditing tool that keeps accurate record of which persons accessed any given file at any given time
17. How can you check for preinstallation steps that might be necessary before upgrading to OS/2?
 - a. run the PREINST utility
 - b. run the PREPMNT utility
 - c. check the existing CHKPNT log file in the System directory
 - d. run the CHKINST utility

18. What program can you run that will help Windows NT 4.0 or Windows 2000 installations to proceed much faster?
 - a. SMARTDRV
 - b. QUICKTIME
 - c. POGOSTCK
 - d. SPEEDISK
19. Windows 2000 offers what new directory service?
 - a. NDS
 - b. DDNS
 - c. WINS
 - d. Active Directory
20. Why aren't there PDCs and BDCs in a Windows 2000 domain?
 - a. Windows 2000 has finally discarded the outdated domain model.
 - b. All domain controllers in Windows 2000 are peer domain controllers.
 - c. All Windows 2000 servers are member servers only.
 - d. All Windows 2000 servers are stand-alone servers only.

HANDS-ON PROJECTS



Project 8-1

In this project, you will analyze the hardware on three systems (see Table 8-1) and determine which one is least acceptable as a NetWare 5.1 server installation candidate. The server will run the WebSphere Application Server for NetWare.

Table 8-1 Choices for Project 8-1

Server1	Server2	Server3
Pentium III Xeon 733 MHz	Pentium II Xeon 400 MHz	Pentium II 233 MHz
1 GB of free disk space	4 GB of free disk space	2 GB of free disk space
1 GB of RAM	128 MB of RAM	512 MB of RAM

Which of the servers in Table 8-1 is the best candidate? Explain why the other two servers would not be the best choice.



Project 8-2

In this project, you will install the Windows 2000 Server operating system on a server. Before installation, verify that the hard disk has at least 2 GB of FAT- or FAT32-formatted disk space available, a 133 MHz Pentium or compatible processor, and 128 MB of RAM.

1. Insert a boot floppy with CD-ROM drivers for the server CD-ROM or a Windows 98 startup disk, and boot the computer. If the server is El Torito-capable, then boot from the CD-ROM (you might have to specify this boot option in the CMOS). If booting from the CD-ROM, skip to Step 5.
2. If you booted from a floppy, be sure to type **SMARTDRV** and press **Enter** at a command prompt. This loads the Smart Drive caching utility. If you booted from the CD, then caching loads automatically. If necessary, be sure to manually add the SMARTDRV.EXE file to the boot floppy.
3. If prompted, specify the location where the Windows 2000 files are located. In most cases, this will be D:\i386, where D is the CD-ROM drive, and the entry probably already appears by default. Press **Enter** to start the file copy process.
4. Remove the bootable media, whether it's the floppy or the CD-ROM, and press **Enter** to reboot. If you do not remove the media, the installation might start over again.
5. If you have a SCSI host adapter, press **F6** when prompted. Otherwise, skip to Step 7.
6. Press **S** to direct Windows 2000 to look for the SCSI drivers. You will need a floppy diskette containing the drivers.
7. A prompt appears asking whether you want to repair an existing installation or proceed with a Windows 2000 installation. Press **Enter** to set up Windows 2000.
8. The license agreement appears. Press the **F8** key to indicate that you agree.
9. You are prompted to select a destination for the installation. In this screen, you can create or delete partitions as necessary. You probably have a C: partition already formatted. Make sure to select it and press **Enter**.
10. Choose the option to **Convert the partition to NTFS** and press **Enter**.
11. Press **C** to confirm that you want to convert the partition to NTFS.
12. Setup examines your hard disk, and then begins to copy more files to the local drive. Afterward, the system reboots itself (or you can hasten this by 15 seconds by pressing **Enter** at the prompt).
13. The file system conversion to NTFS takes place, and a reboot occurs. No steps are required on your part.
14. Setup boots into the GUI mode of setup, and your first prompt is for regional settings. Adjust these if necessary, and click **Next** through the GUI screens as you complete Steps 15 through 23.



Unless necessary, don't change these settings, because it will be much more difficult to read the screens later on when they're in a foreign language and the keyboard layout has changed.

15. Enter a Name and Organization.
16. When prompted, enter the CD-KEY.
17. Leave the licensing mode at per server, and enter a number at least equal to the number of computers in the classroom.
18. A randomly generated computer name appears. Change it if you like or as directed by your instructor.
19. Enter and confirm a password. Record the password so you don't forget it.
20. A list of Windows components appears. You can click around and view the various options if you like, but for now, leave the options as selected.
21. Enter the correct date, time, and time zone as necessary.
22. Leave the Network Settings at the default Typical settings.
23. Leave the computer in a workgroup with the default name "workgroup."
24. When setup is complete, click **Finish** to reboot the system. The server will now boot into Windows 2000, ready for use.



Project 8-3

In this project, you will configure the paging file for Windows 2000 Server.

1. Right-click **My Computer** on the Windows 2000 desktop.
2. Click **Properties**.
3. Click the **Advanced** tab.
4. Click the **Performance Options** button.
5. Click the **Change** button in the Virtual memory frame.
6. You probably have a drive C with a specific paging file size already set. Change the initial size to **300** and the maximum size to **600**. (These are somewhat arbitrary numbers; in a later chapter, we discuss sizing the paging file.)
7. Click the **Set** button.
8. Click **OK** on all open dialog boxes.
9. A prompt notifies you that you must reboot. Click **Yes** to allow the reboot to occur.
10. When the system reboots, the paging file will be reset to the new sizes. Repeat Steps 1–5 to confirm this, and then cancel all open dialog boxes.



Project 8-4

In this project, you will apply one or more updates to the newly installed Windows 2000 installation completed in Project 8-2.

1. In Windows 2000, click the **Start** button and select **Windows Update**.
2. Click the link that says **Product Updates**. An ActiveX utility scans your system to see what updates have been applied and what updates might be useful for you.
3. What updates are available for your installation of Windows 2000? Select some updates. Look carefully at the size of the downloads; if your Internet connection is slow, be conservative in the interest of time.
4. When you have selected the updates you want, click the **Download** button. A summary screen shows you what is about to be downloaded.
5. Click **Start Download**, and then click the **Yes** button in the license agreement screen.
6. The update takes place. If you see a prompt to reboot, go ahead and do so.
7. Your system has now been updated with the components you selected.
8. Return to the Windows Update site, and click the link that shows you which updates have been applied to your system. Notice that you can uninstall updates, which is sometimes necessary if the update has an unexpected and detrimental effect.



Project 8-5

In this project, you will identify features of the Red Hat Linux operating system.

1. Browse to *www.redhat.com*.
2. Browse to the Products and Services section.
3. Select the **High Availability Server**. What support is included with this product?
4. Access product information for the Red Hat Professional Server. It is important to choose a NOS that has applications available for it. What are a few of the software packages included with this product?
5. Close the browser.



Project 8-6

In this project, you will find more detailed information about OS/2 from the Redbooks IBM site.

1. Open your web browser to *www.redbooks.ibm.com*.
2. Select the link for **Redbooks online**.
3. In the Redbook Site Search, enter the words “OS/2 warp server” and click **Search**.
4. Select the search result **OS/2 Warp Server for e-business**. If this item does not appear, enter a new search for **SG24-5393**, which is the corresponding document number.

5. Select the link that allows you to view this redbook document online. Choose to view using the PDF link. Adobe Acrobat Reader must be installed. If necessary, you can detour to *www.adobe.com* to download and install the software and then return to this site.
6. Using the navigation bar at the bottom of the PDF file, access page 35 of 472. How much virtual memory address space can applications address?
7. Access page 118 of 472. Under Section 4.1.4, what limitation does JFS have?
8. Browse through other chapters and write down four more features about OS/2 that you think would be of significance to server administrators. Chapters 1 and 2 will probably provide the best information.

CASE PROJECTS



1. Mario, a new administrator in your Hopewell, VA remote site, has recently purchased an inexpensive server with no operating system. Mario installed NetWare 5.1 on the server and successfully joined it to the existing NetWare tree in your organization. Unfortunately, even though the demands on Mario's server are moderate, it seems to respond very slowly to client requests. Mario says that the hard disk is constantly active. User files take a long time to load, and the email application on the NetWare server does not perform acceptably. What do you think is the problem, and what could Mario have done to avoid this situation?
2. Tammy's supervisor tells her to procure a dual-processor Pentium III Xeon server as a logon server/print server with 1 GB of memory and an 80 GB array of SCSI disks. Tammy just learned that the graphics division is moving to her floor, and she must provide print support for PostScript print jobs, but she does not have a PostScript printer. Also, because the server is a file server, Tammy decides she wants the best possible reliability she can find for the file system in case files become corrupt during a write action. Tammy thinks that her shiny new server will provide plenty of power, but she is unsure of which operating system would work best for her needs. What would you tell Tammy to do?